The WHAT'S NEW magazine

APRIL 1986

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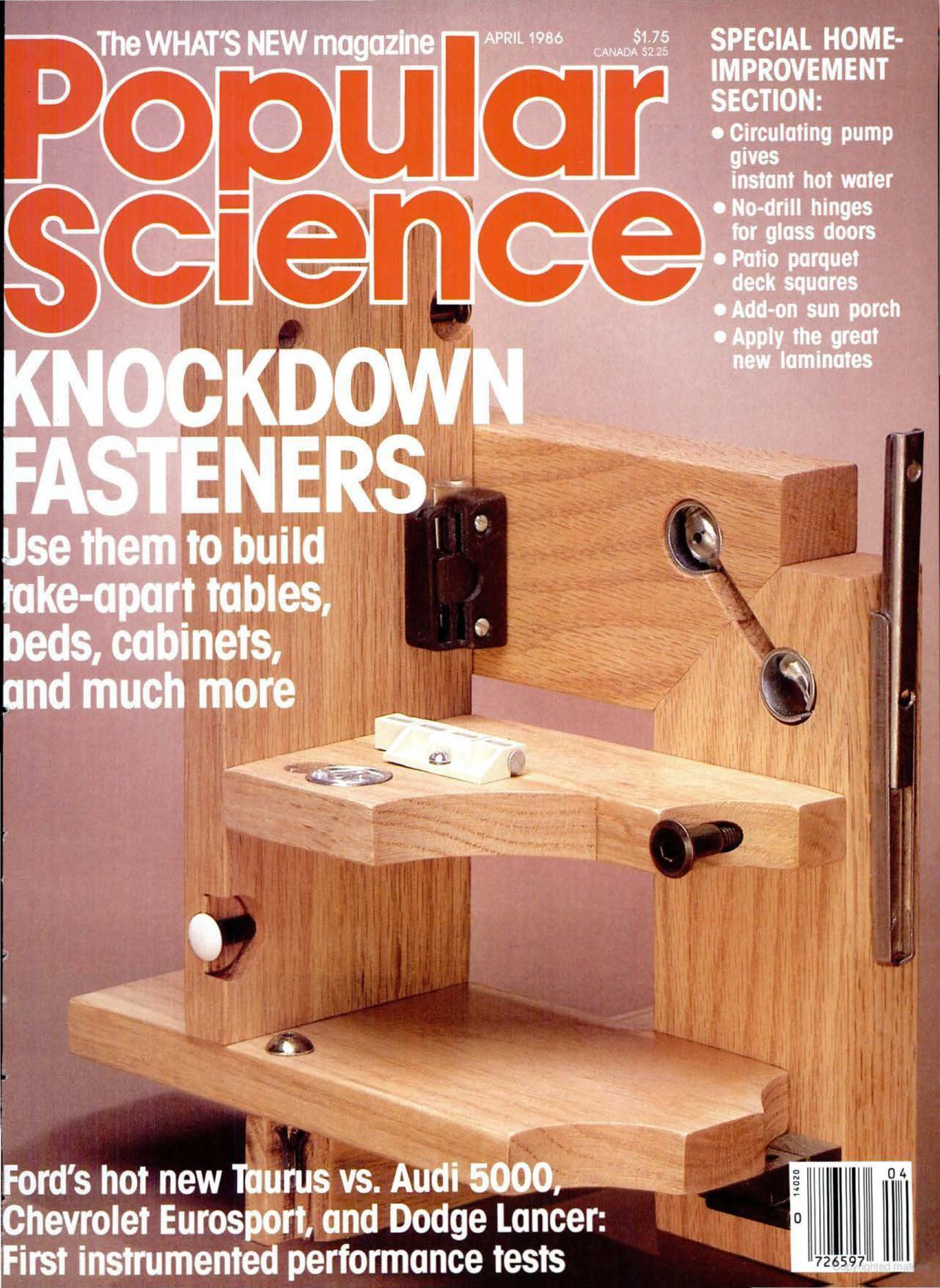


SPECIAL HOME-IMPROVEMENT SECTION:

- Circulating pump gives instant hot water
- No-drill hinges for glass doors
- Patio parquet deck squares
- Add-on sun porch
- Apply the great new laminates

KNOCKDOWN FASTENERS

Use them to build take-apart tables, beds, cabinets, and much more

Ford's hot new Taurus vs. Audi 5000, Chevrolet Eurosport, and Dodge Lancer: First instrumented performance tests

TAURUS
11G 743

One of the many examples of Ford's attention to detail is the cargo restraining net on the LX. It helps keep grocery bags from tipping over and loose packages from sliding around.

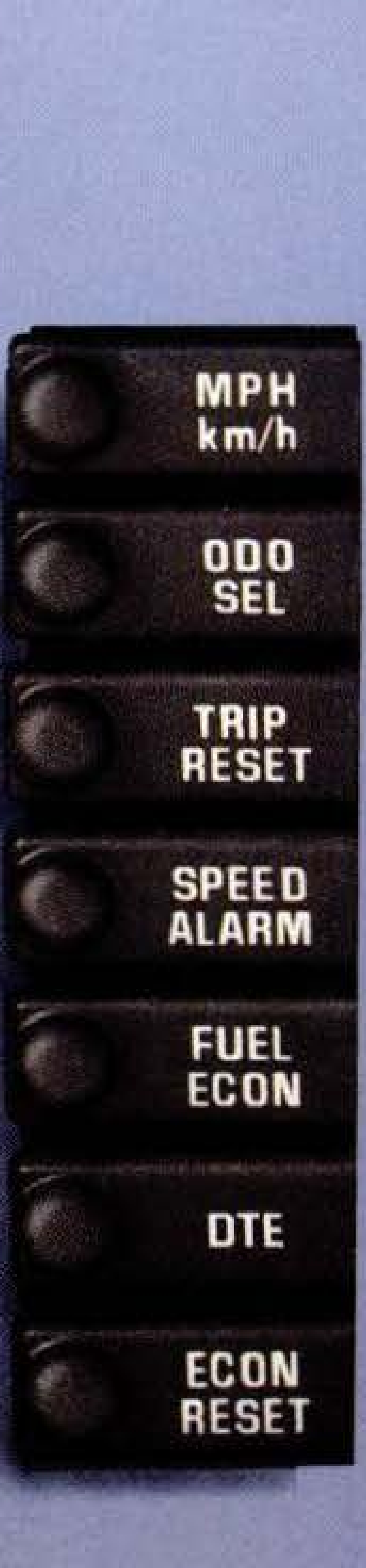
THE NEW FO ITS PERFORMAN TO WHAT'S UN

The mark of a well-designed automobile is total performance.

In the case of Taurus, that means a powerful 3-liter, V-6 engine. Plus dozens of other features that not only respond to the needs of the driver, but to those of the passengers as well

As a result, Taurus performs beautifully.

Even the smallest details have been carefully thought out. For example, the shape of this light switch and its position on the instrument panel make the simple task of turning on the lights as easy as possible.



The trip computer is part of the optional electronic instrument cluster. It provides valuable travel information such as rate of fuel consumption and the distance you can travel until empty.

The optional electronic instrument panel is designed to be "user friendly." All instruments are easy to read and all controls are placed where your hands can easily find them.

RD TAURUS.
CE ISN'T LIMITED
DER THE HOOD.

The secondary sun visor helps eliminate glare from the front and side simultaneously, so you don't have the inconvenience of constantly swinging the visor back and forth. It's not available on the L model.

Right down to the smallest detail.

The best-built American cars.

At Ford, Quality is Job 1. A 1985 survey established that Ford makes the best-built American cars. This is based on an average number of problems reported by owners in a six-month period on 1981-1984 models designed and built in the U.S.

Have you driven a Ford...lately?

This One
63XP-UQ3-F2QH

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The WHAT'S NEW magazine
Popular Science®

APRIL 1986 Founded in 1872/Vol. 228, No. 4

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20 knockout knockdown fasteners

Put them together; take them apart—innovative fasteners let you build collapsible furniture.

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Cover photo by Greg Sharko

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Readers Talk Back

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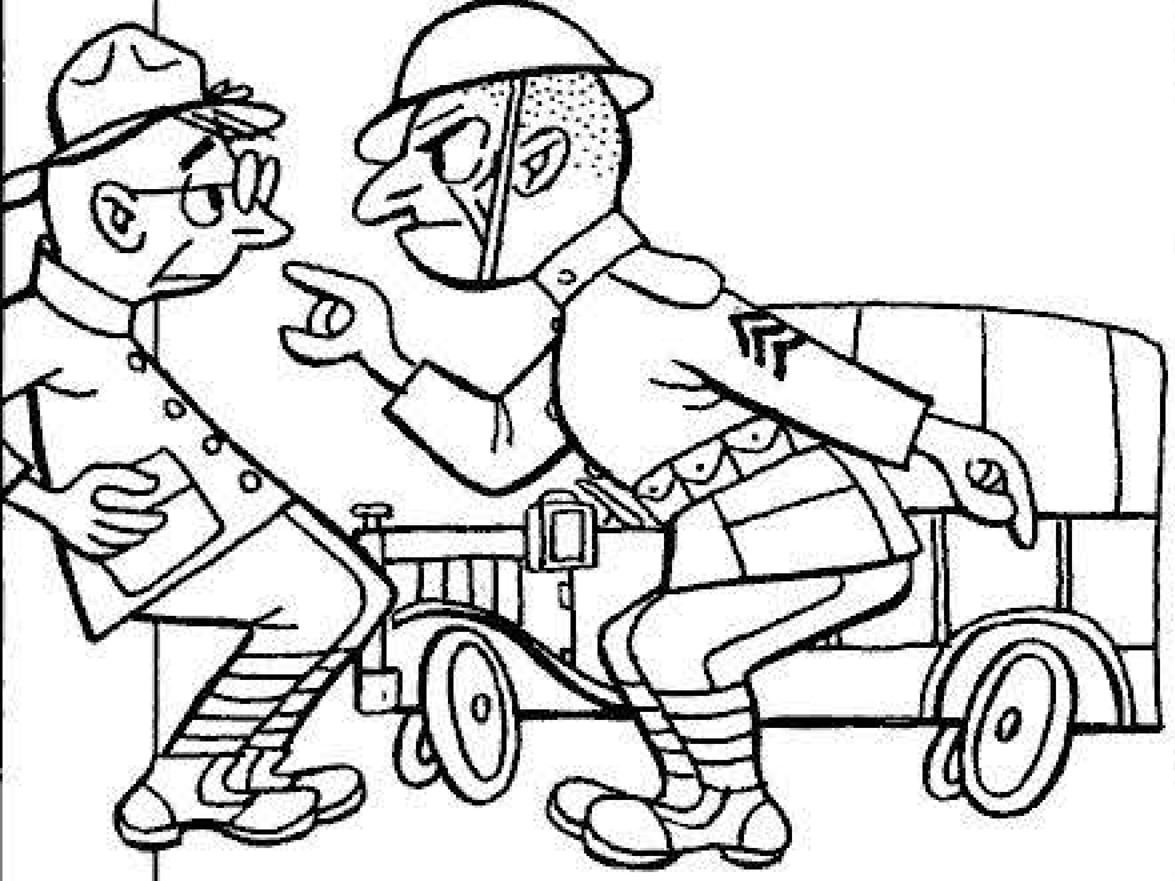

Famous last words

A mechanics instructor of mine in World War II enjoyed telling about the primitive four-wheel steering used on military vehicles in World War I ["4-Wheel Steering," Feb.]. According to him, trucks with four-wheel steering would pull up parallel to a loading dock. When they started to drive away, the front wheels would turn left and the rear wheels right—and the trucks would be jammed against the loading dock. The story always ended with the instructor insisting that four-wheel steering would never work.

George L. Carey
Salt Lake City, Utah

Trucks didn't stop

I think it's strange that General Motors (and others) are fitting cars with computerized anti-skid brakes after the failure of those brakes on commercial vehicles in the late 1970s ["Brakes with Brains Stop Like a Pro," Nov. '85]. Truckers found out the hard way that computerized brakes were difficult to maintain, costly, and undependable.

James C. Thompson, Pres.
General Delivery Trucking
Fairmont, W. Va.

Stuart F. Brown replies: "A major problem affecting early truck anti-skid braking systems was radio interference with the systems' electronic controls. Some of that interference was caused by truckers' powerful CB radios. Extensive interference shielding built into the present anti-skid systems has solved that problem."

Diamonds aren't new

A joined-wing airplane ["Diamonds Are a Plane's Best Friend," Jan.] is a fascinating concept, but not a new one. In the late 1940s, an engineer at the National Advisory Committee for Aeronautics (predecessor of NASA) proposed this concept as a way of achieving lighter weight through increased structural rigidity. The concept also offered the aerodynamic advantage of swept-back wings for high-speed flight. Several small models were built and successfully flown. No practical application for the design was apparent, so the project was dropped. Given the latest advances in materials technology, applications will no doubt be forthcoming.

J. E. Tomassoni
Seabrook, Md.

No spark plugs, big savings

As a former assistant chief engineer in General Motors' AC Spark Plug Division, I think your article on spark plugs ["Science Newsfront," Feb.] underestimated how much these jack up gas prices. Getting rid of spark plugs would save consumers much more than $10 billion a year—your figure for what it costs to produce the high-octane gasoline needed for spark plugs. The United States uses about 102 billion gallons of gasoline annually. You pay about four cents for every octane per gallon. So one octane number costs consumers roughly $4 billion. Refineries boost the octane number of crude oil from 70 to 90 for spark plugs—that's 20 octane numbers. While the relationship of price to octane number isn't linear over that 20-octane-number range, your $10 billion estimate is off by at least a factor of three.

John A. McDougal, P.E.
Detroit, Mich.

Safer chimneys

I'd like to add a couple of safety tips to "Install a Fireplace Insert" [Dec. '85]. Before installation, get a guild-certified chimney sweep to check the chimney's integrity. Most sweeps perform this service for a nominal fee. Second, Underwriters Laboratories

Continued

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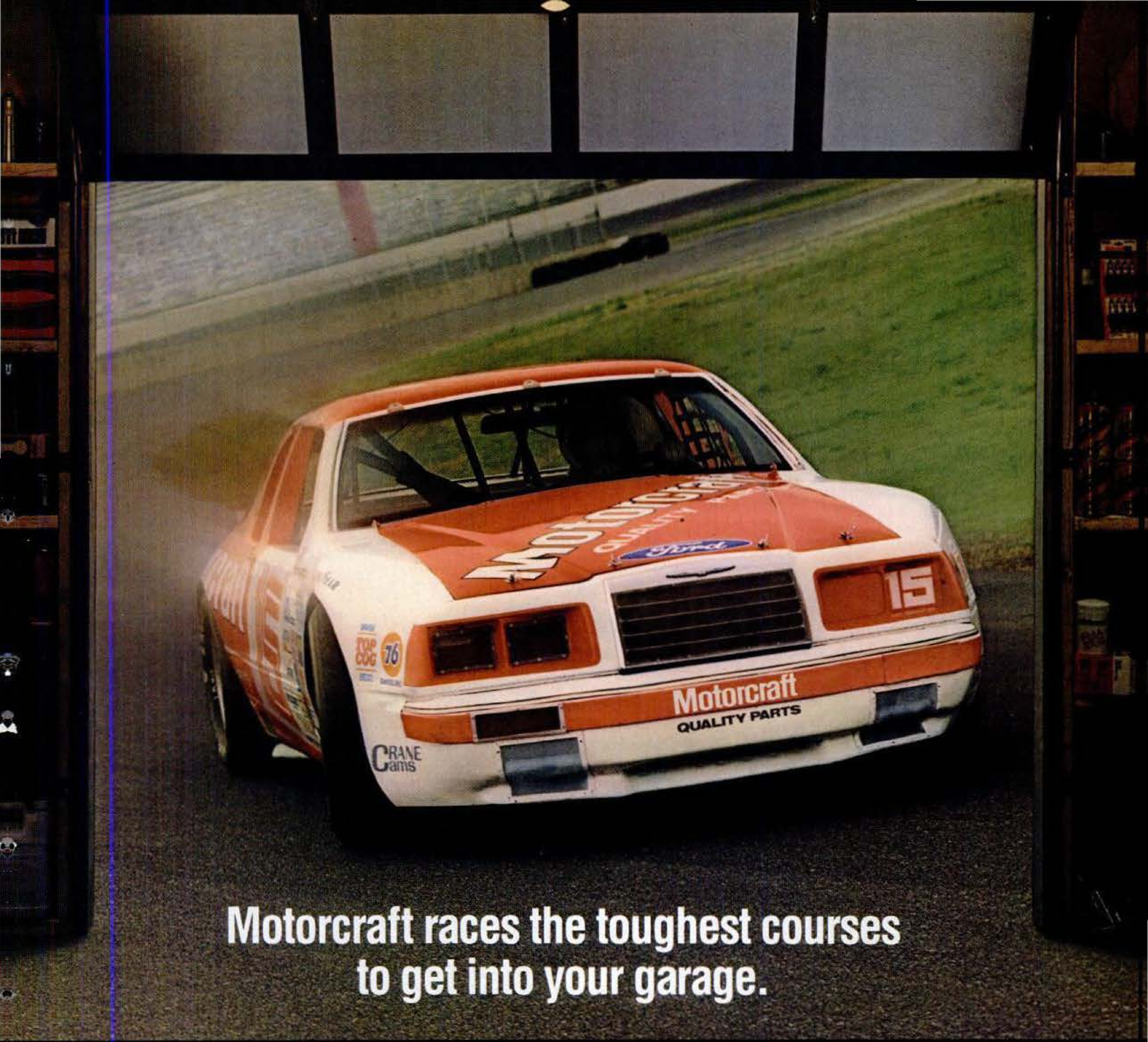

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Readers Talk Back

Continued

frowns on loose insulation. Instead of using only vermiculite around the relining pipe (if one is required), add some portland cement and water to make a slurry. When this mixture hardens, there's no chance of it coming out of the chimney.

J. Isenhour, Chm., Tech. Committee
N.C. Guild of Professional
Chimney Sweeps, Tryon, N.C.

Geography lesson

I read with interest "Now: Anti-Collision Radar for Your Car" [Jan.], but your geography is a little fuzzy. The article states that dense fog in the Mount Clemens and Anchorville area is caused by Lake Michigan. I live between those two towns and right off the shores of Lake St. Clair, which is the true source of the fog. Lake Michigan is 150 miles away.

Mark Hurttgam
New Baltimore, Mich.

Whatever became of...

The January 1975 issue of POPULAR SCIENCE contained an article on Sonadisc, which claimed to be a solid-state digital recorder using magnetic-bubble technology to store and play back music. The article said the device, no larger than a cigar box, could hold all the songs written since 1900. Sounds like just the thing to handle my extensive record collection. Where can I buy one?

Francis Pivar, New Kensington, Pa.

John Free replies: "Bubble memories aren't yet cheap enough and don't have enough capacity to put ideas like Sonadisc on the market. You might want to consider erasable optical discs, almost ready for marketing, which also have large storage capacities."

Corrections: The suggested list price of the Makita 3⅜-inch circular saw featured in "No Place to Plug In?" [Dec. '85] is $165.

In the December '85 car test, the interior noise levels for the Audi and the BMW should have been 61 and 66 dBA, respectively.

The wingspan for the SCM glider shown on January's cover ["Diamonds Are a Plane's Best Friend"] is 44.3 feet (13.5 meters), not 80 feet.

A caption in February's "The Rush to Hush Computer Printers" incorrectly labeled a tiger as a lion.

The fractionator-tower, graduated-cylinder, and fuel-injector photos in "Bad Gas" [March] should have been numbered 1, 2, and 3, respectively. PS

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Small means nearly-invisible protection

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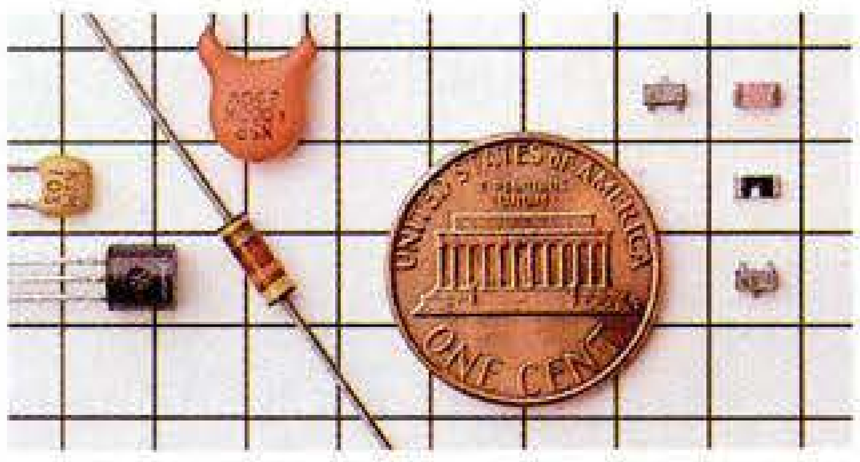
This miniaturization is possible only with SMDs (Surface Mounted Devices), micro-electronics common in satellites but unprecedented in radar detectors. It's no surprise that such a superlative design should be greeted by superlatives from the experts.

"In a word, the Passport is a winner," said *Car and Driver.*

The experts report excellent performance. Simply switch PASSPORT on and adjust the volume knob. Upon radar contact, the alert lamp glows and the variable-pulse audio begins a slow warning: "beep" for X band radar, "brap" for K band. Simultaneously a bar graph of Hewlett-Packard LEDs shows radar proximity.

Small means the size of a cassette tape

As you get closer, the pulse quickens and the bar graph lengthens. Should you want to defeat the audible warning during a long radar encounter, a special switch provides silence, yet leaves PASSPORT fully armed for the next encounter. A photocell adjusts alert lamp brightness to the light level in your car. PASSPORT was designed for your protection *and* your convenience.



In PASSPORT, 102 SMDs (right) do the work of ordinary transistors, resistors and capacitors.

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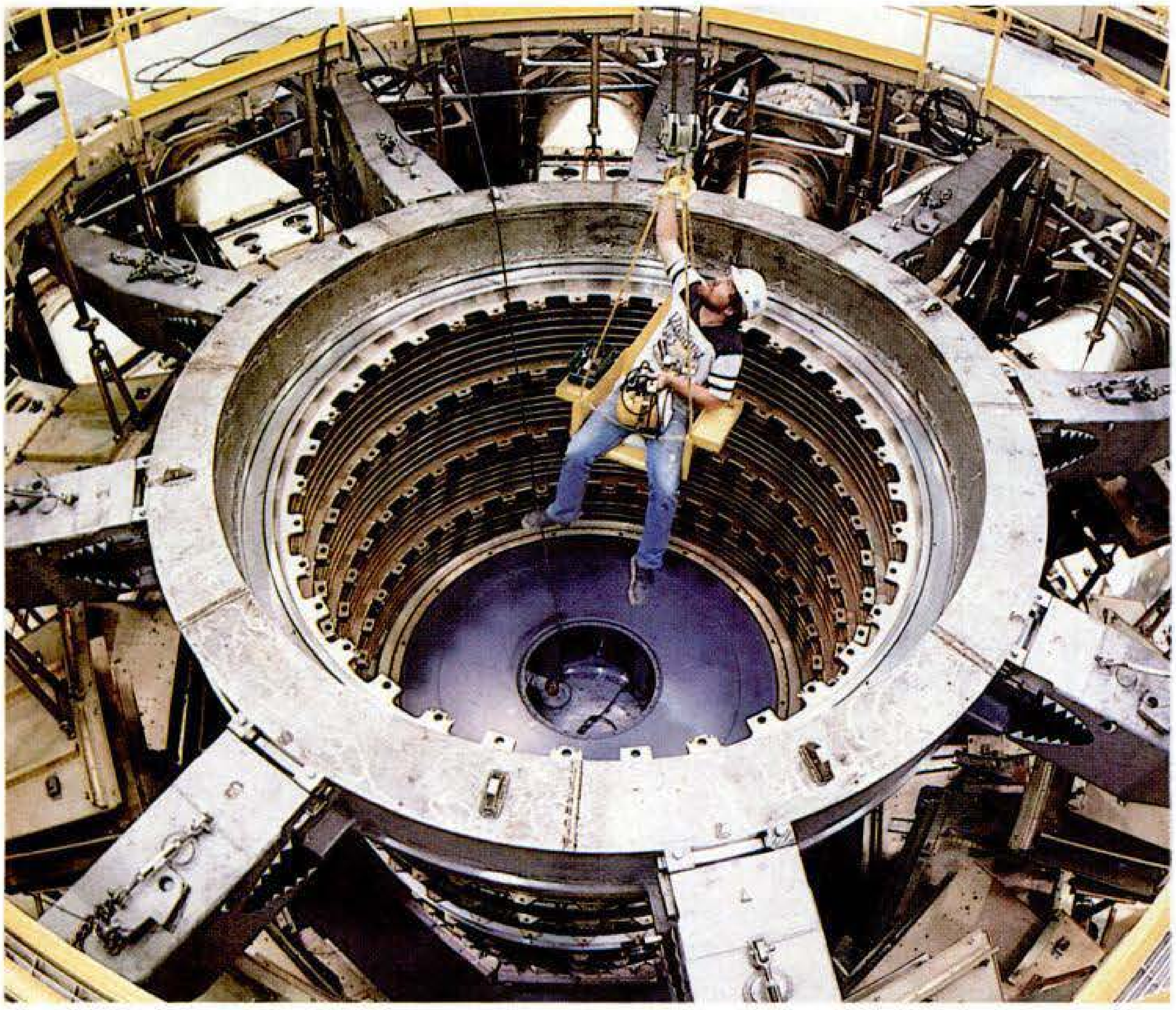
Science Newsfront

By ARTHUR FISHER



Fusion milestone

Well, maybe a yardstone. There have been so many "milestones" proclaimed in the decades-long and arduous march toward controlled-fusion energy that I hesitate to nominate another. But what happened last December at Sandia National Laboratories, in Albuquerque, N.M., does seem a significant advance in fusion research—if not a shot heard around the world, then certainly a very big bang.

The shot was the first successful firing of the world's most powerful particle accelerator, PBFA-II, shown in these illustrations. (The acronym stands for particle-beam fusion accelerator.) The accelerator delivered a burst of ions, lasting 50 billionths of a second, to a diode in the experiment cavity seen in the photo. The shot was at 70 percent of capacity; PBFA-II is designed to deliver at least 100 trillion watts of power—greater than the instantaneous output of all the power plants on Earth. After more development work, the accelerator will aim a beam of lithium ions onto a pea-sized pellet of deuterium and tritium fusion fuel. The enormous beam power will, Sandia scientists hope, compress the hydrogen fuel 1,000 times and heat it to 100 million degrees C, causing ignition—a small, controlled, thermo-

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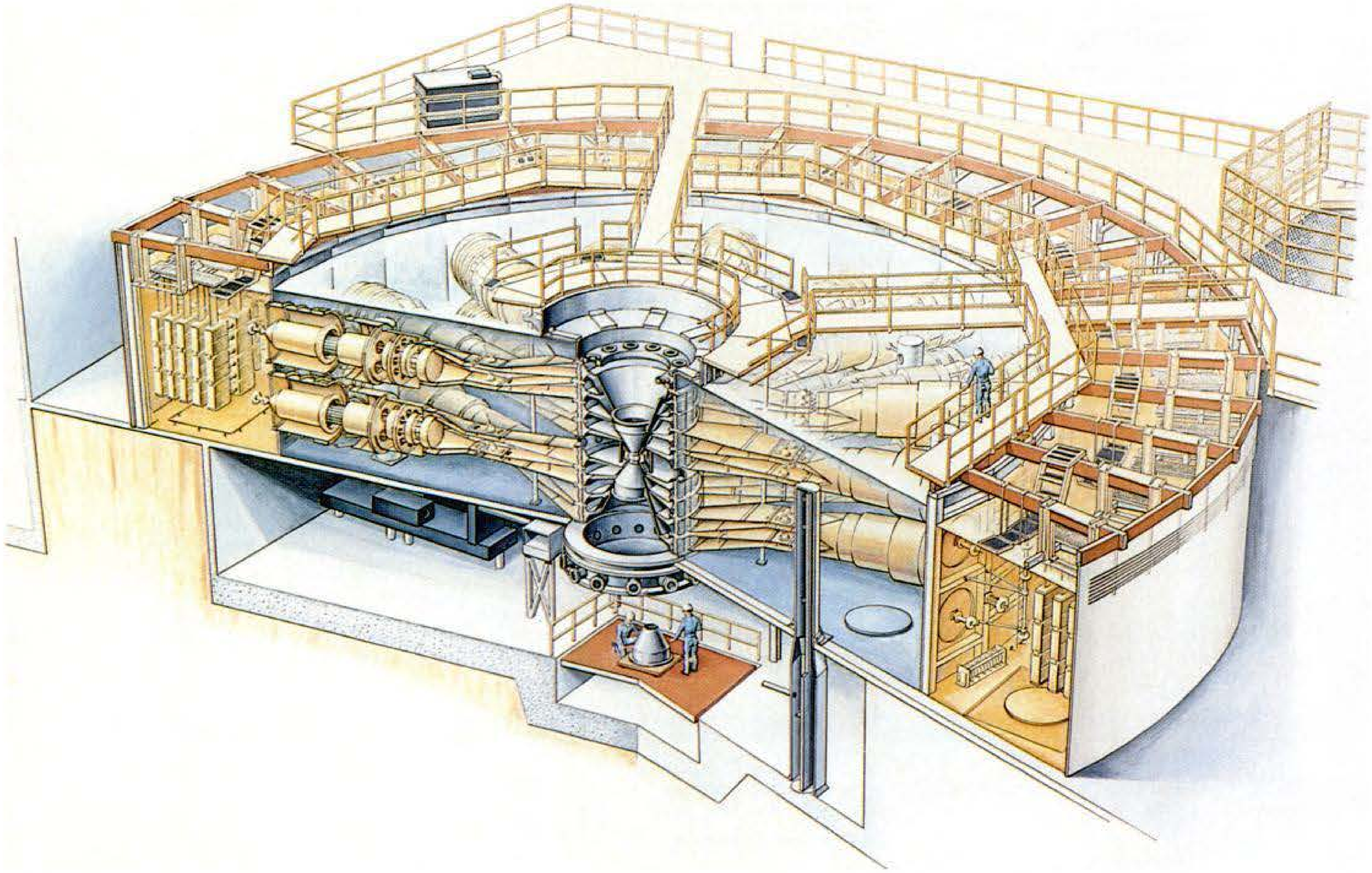

Family room.

Take some of the best things about your family room, put them on four wheels, and you begin to get the idea of what a Dodge wagon is all about.

Because, inside a Dodge you'll find plenty of living room for you and your family. Even our smallest wagon has available seating for 8 people. And our B-350 Maxiwagon can handle a family reunion with optional seating for up to 15 full-size adults.

You'll find a Dodge wagon comfortable. Comfortable to drive. With standard features like power steering and power front disc brakes. And comfortable to ride in. With luxury options like plush command chairs, tilt steering wheel, front and rear air conditioning and heat on most models, and an outstanding AM stereo/FM stereo system with cassette.

You'll also find that a Dodge wagon is solidly built. In fact, Dodge wagons are built so well, they're the only wagons covered by a standard 5 year/50,000 mile Protection Plan. The best truck warranty in the business.

Only Dodge Backs Every Truck It Builds With 5/50 Protection, Standard.

We have so much confidence in the quality of the trucks we build, we back them with the same warranty we give the cars we build. With our standard 5 year or 50,000 mile Protection Plan.* Nobody else...not Ford, not Chevy, not the imports... does that. When we say we build tough trucks, we prove it.

Put all this together and you can see why Dodge has been the #1 selling line of wagons in America for the past 3 years. So, join the crowd. You'll make a nice fit in a wagon built by Dodge.

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5/50 RAM TOUGH

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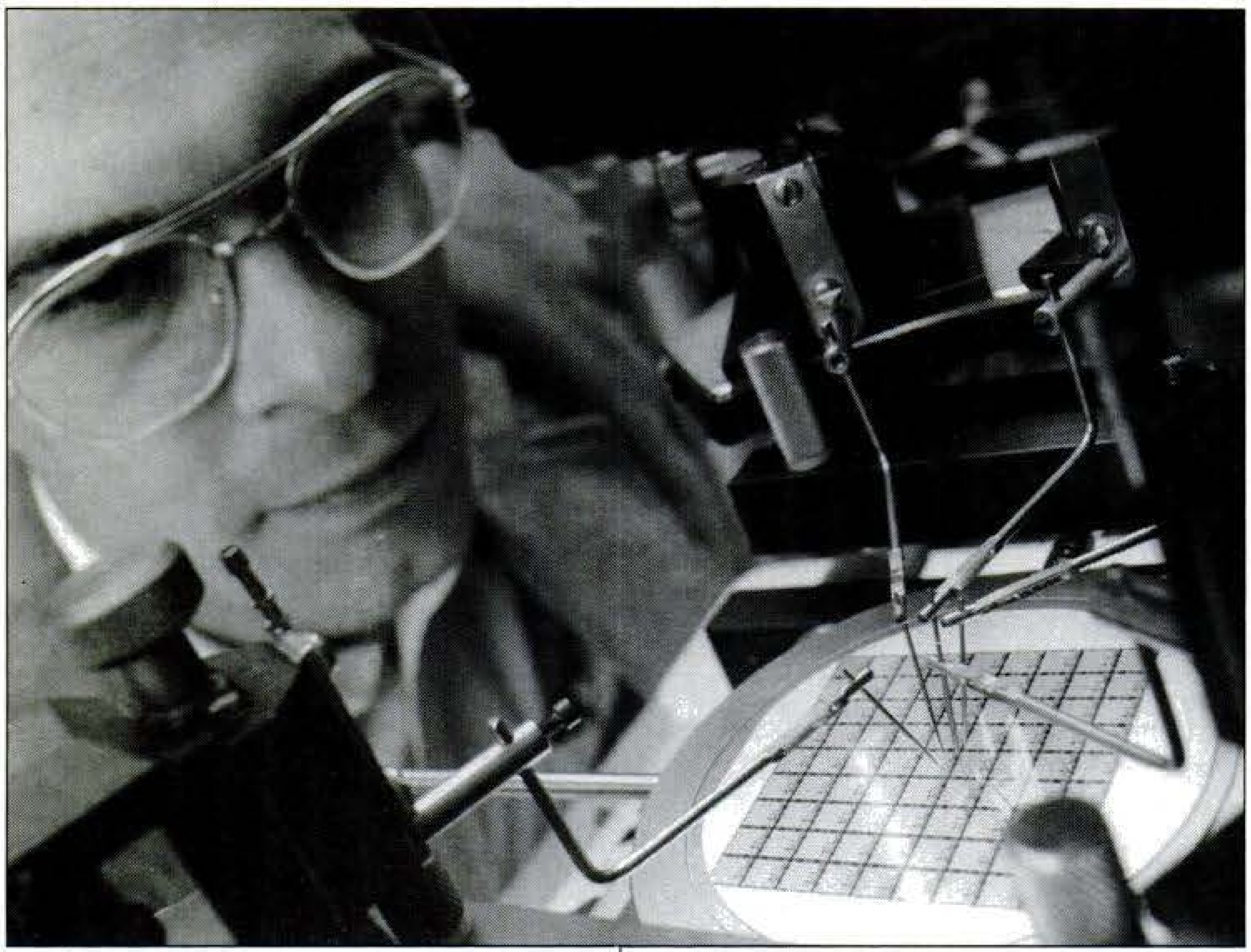
SURGEON GENERAL'S WARNING: Quitting Smoking Now Greatly Reduces Serious Risks to Your Health.

16 mg "tar," 1.0 mg nicotine
av. per cigarette, FTC Report Feb.'85



nuclear explosion. Eventually, such experiments could lead to fusion reactions with a net energy gain, the long-sought prerequisite for fusion power plants.

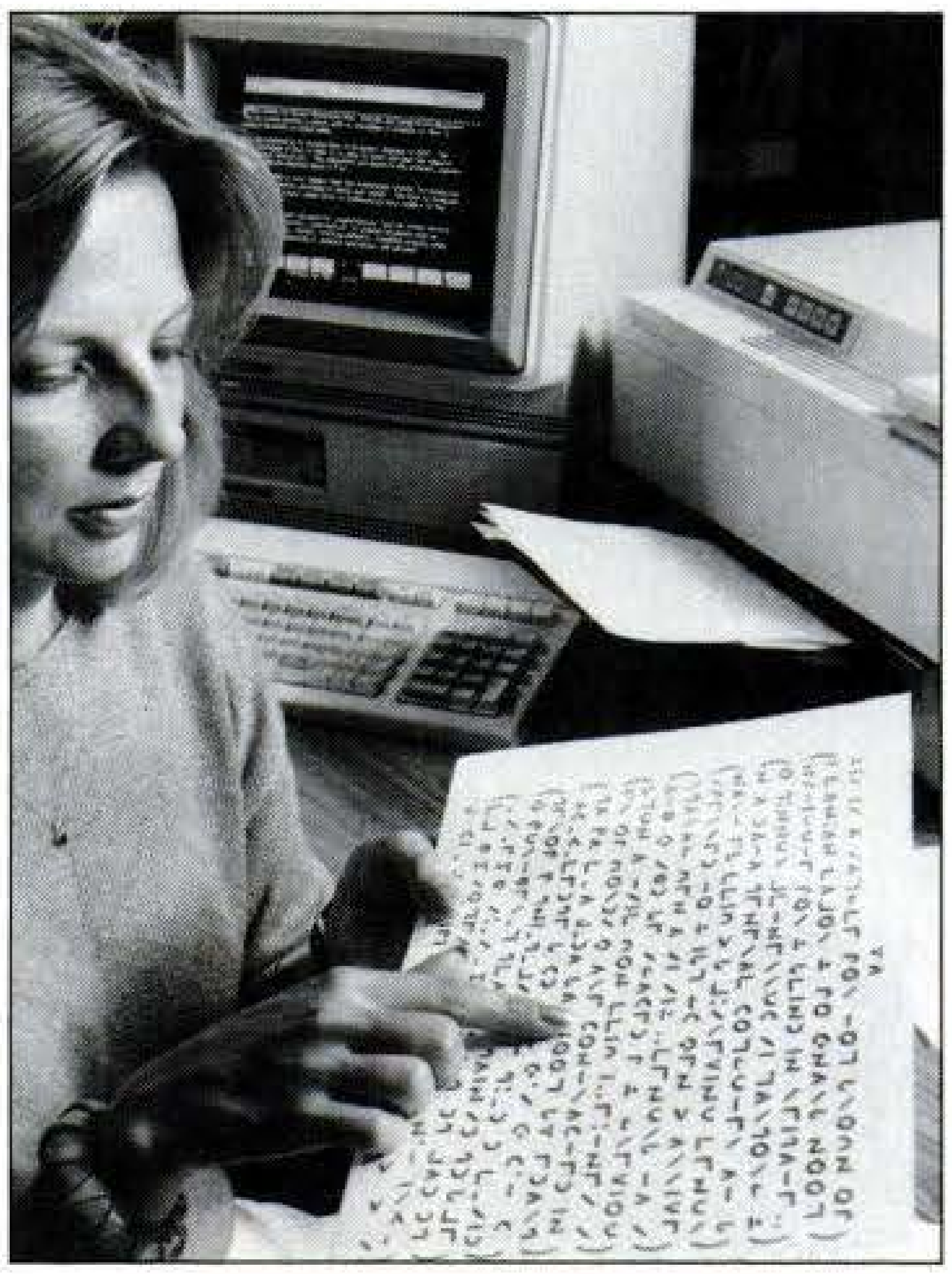
Although the scale of PBFA-II is suggested by the cutaway drawing, it is hard to grasp unless you walk over the catwalks from the circumference to the center, as I did a few weeks before the test shot. This is a giant machine, arranged like a 108-foot-diameter wheel with nine spokes, each consisting of a four-layer stack of electrical modules. Each of these 36 modules is a string of capacitors, switches, and transmission lines converging on the central hub, a vacuum chamber that will house a diode where the fuel pellet will be placed. During a shot, electrical current storms through each module simultaneously, and into the diode, generating an intense beam of lithium ions, which in turn will be focused on the pellet. The electric modules are submerged in oil and water in separate sections of a 20-foot tank that could hold the contents of 2⅔ Olympic swimming pools. During the test shot, the liquid surface glowed and crackled with vivid blue electrical discharges, evidence of the awesome power being unleashed.

Smart chips

Dr. Eric J. Wildi (photo above) of General Electric Co.'s Research and Development Center gets ready to test a wafer containing dozens of new semiconductor switches called lateral insulated gate transistors (IGTs). The experimental device is designed so that it can be incorporated in the new family of smart chips that integrate logic and high-voltage circuits, enabling them to handle 10 times as much power as they can now ["The Control Revolution," PS, Nov. '85].

BUMBLE meets Moon

The woman in the photo below is reading Moon, an embossed language for the blind that is easier to learn than traditional Braille. What's new is that this example was not produced by the slow, hand-set printing technique necessary until now, but by a new computerized system that allows a typist to generate Moon documents simply by typing in English. The system uses a 16-bit microcomputer, a laser printer, and special software. It is called BUMBLE, for Brunel University Moon, Braille, and large-print equipment (the system can turn out all three), and was developed by Dr. John Gill, of the Research Unit for the Blind, Brunel University, Uxbridge, England.

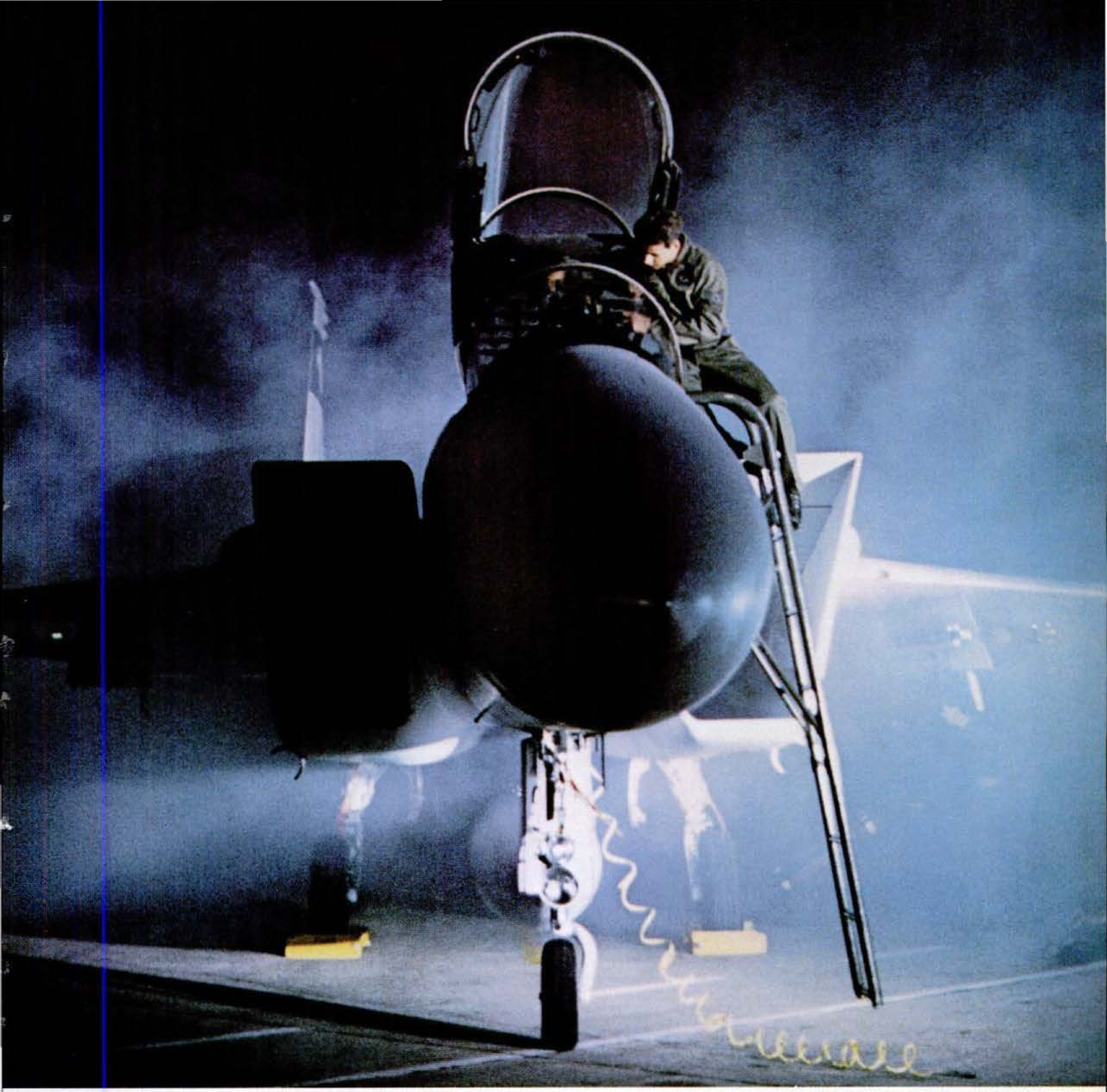


Fifth force?

After all the anguish undergone by physicists trying to accommodate four basic forces in a single coherent theory—the so-called grand unification theory ["Cosmic Order," PS, May '83]—is it fair to introduce a possible fifth force? A team of scientists led by Dr. Ephraim Fischbach at the University of Washington in Seattle has suggested that an extremely weak force called hypercharge does exist. If so, it would wreak havoc with much of what we consider fundamental knowledge of the universe, from Galileo to Newton to Einstein and beyond. Among other niceties, a fifth force would mean that objects of different composition do not fall at the same rate. Before rolling on the floor and chewing the rug, however, consider that Fischbach, et al., have made their proposition on the basis of a statistical reexamination of the results of a 70-year-old experiment conducted by the Hungarian physicist Lóránt (Roland) Eötvös. The existence of a fifth force remains to be demonstrated in the laboratory.

Plants against sewage

With a modified hydroponic system called the nutrient-film technique, agricultural engineers at Cornell University, in Ithaca, N.Y., are using live plants of many species to remove pollutants from sewage at much lower capital-investment and operating costs than those of conventional sewage-treatment facilities. The key to the technique is to grow plants in troughs with a thin film of waste water directed to flow through the plant's roots, which absorb organic and inorganic pollutants, including heavy metals. The system uses three stages, each with a different kind of plant. "It takes only a few hours to turn grossly polluted sewage into highly purified water," says Cornell's William J. Jewell. "Instead of building concrete-and-steel monsters at tremendous costs, we can use this system, which would cost half as much, to do the same job." Jewell will test a 10,000-gallon-per-day installation this spring in Ithaca under the sponsorship of the Gas Research Institute (Chicago) and the N.Y. State Energy Research and Development Authority.



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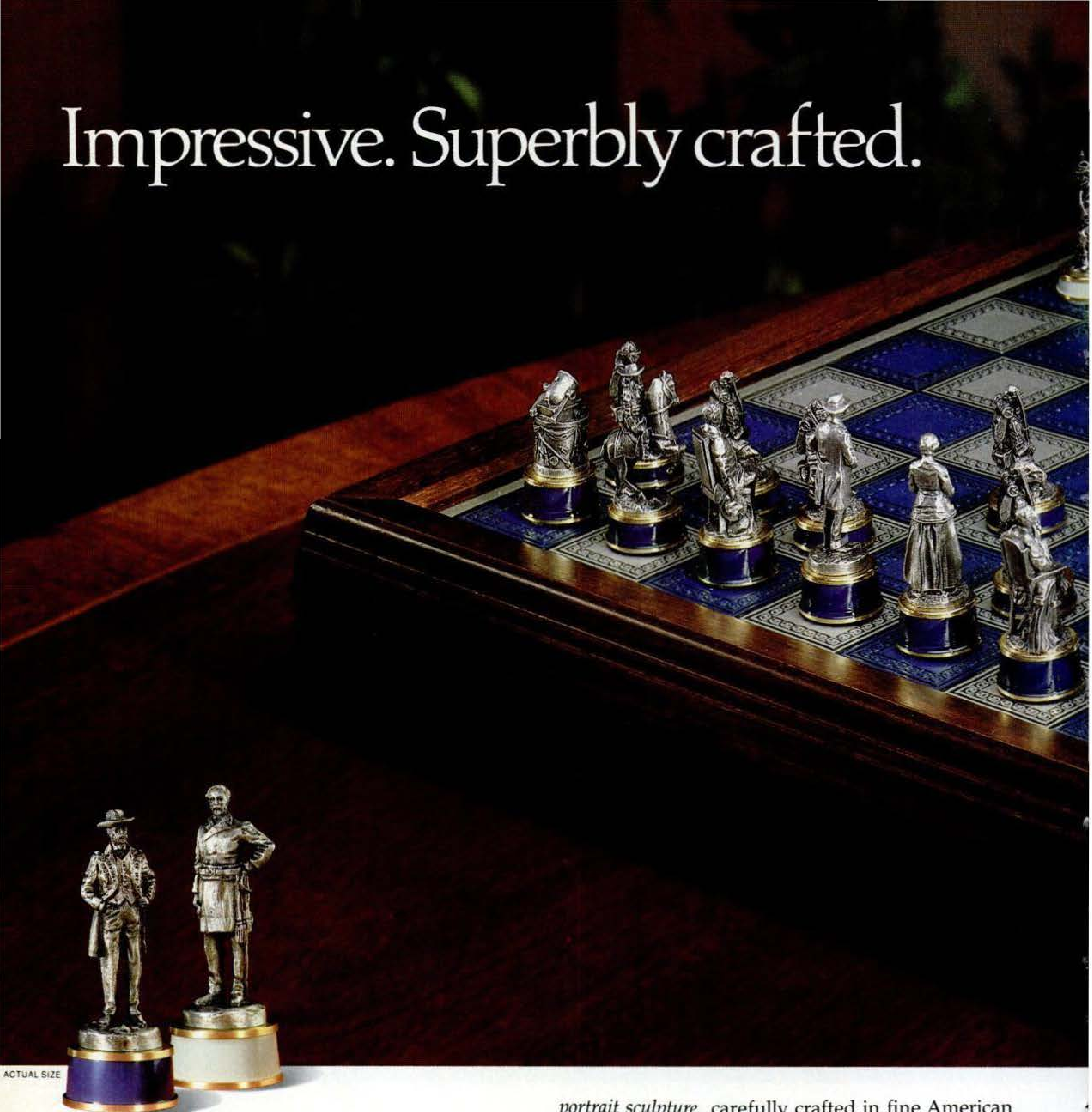
AIR FORCE

Impressive. Superbly crafted.



The Civil War Chess Set.

Issued by The
National Historical Society.

Crafted in America
by The Franklin Mint.

Sculptured, intricately detailed.

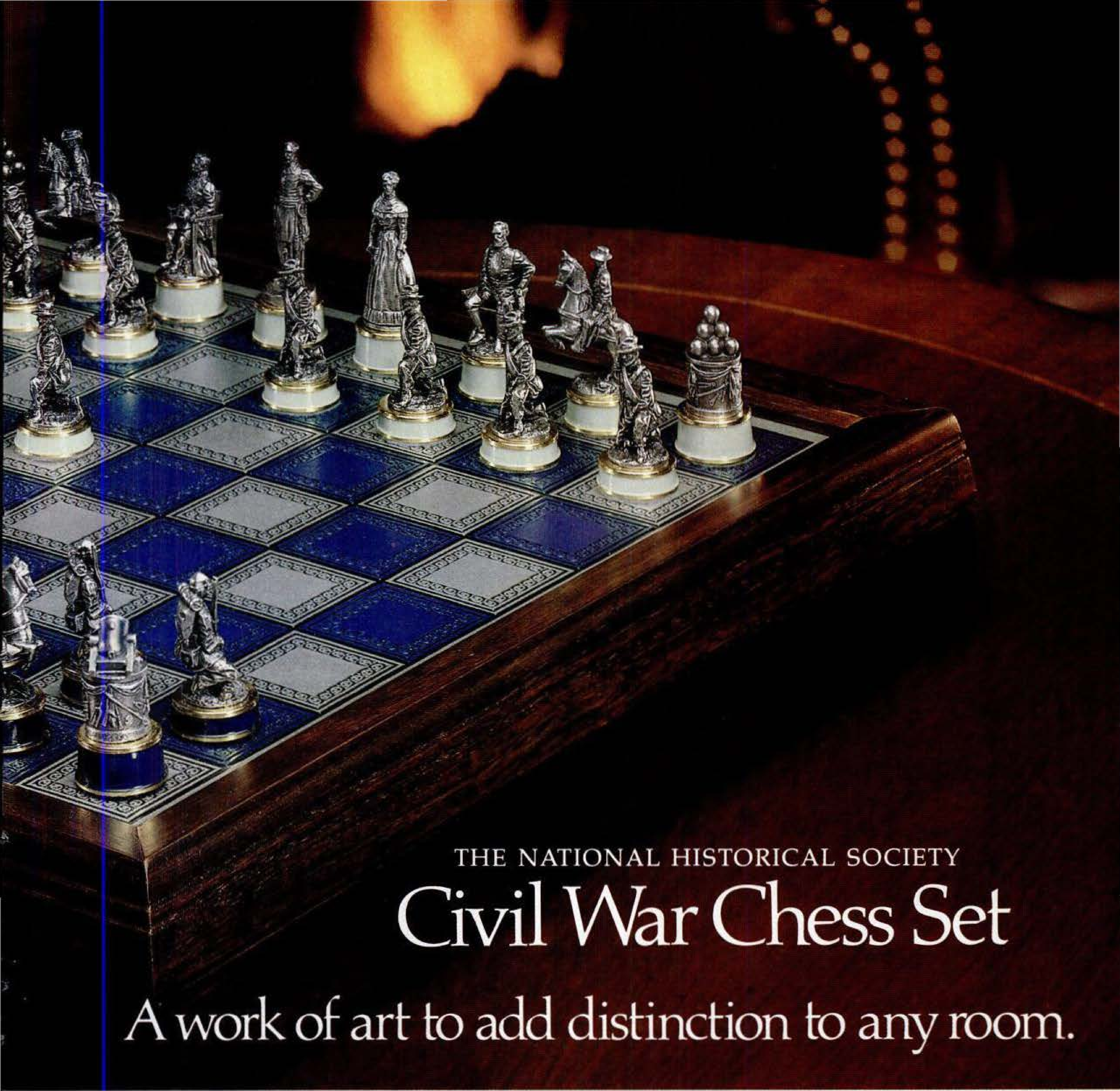
A work of great artistry and historical importance, The Civil War Chess Set will add an accent of imposing grandeur to your home.

Each playing piece is actually a *three-dimensional portrait sculpture,* carefully crafted in fine American pewter and set on a solid brass pedestal base. Each base is *hand-embellished* with a band of rich enamel—blue for the Union forces and gray for the Confederacy. And *every detail* of uniform and weaponry is historically accurate down to the buttons, braiding, sabers and carbines. Even the *facial* expressions of General Grant and Stonewall Jackson have been captured!

Pewter-finished chess board.

You'll receive, as part of the set, a custom-designed playing board finished in pewter, with squares of blue and gray to carry out the Civil War theme—and a fitted case to house all 32 playing pieces.

This is an heirloom chess set you'll want


THE NATIONAL HISTORICAL SOCIETY
Civil War Chess Set
A work of art to add distinction to any room.

to display prominently in your living room, library, den or office. It will be a magnificent enhancement to your decor—inspired by an era that touched the American soul.

Convenient to acquire.

Your chessmen will be sent at the rate of two every *other* month—but you'll be billed for only *one* a month, at the attractive price of $17.50 each. (No added charge for the playing board.) You'll also have the opportunity to complete your set earlier—if you wish.

Enter your order promptly.

To acquire The Civil War Chess Set, for your pleasure and to pass along to future generations, mail your application by April 30th.

© 1986 NHS

SUBSCRIPTION APPLICATION

Please mail by April 30, 1986.
Limit of one set per person.

The Franklin Mint
Franklin Center, Pennsylvania 19091

Please enter my subscription for The Civil War Chess Set, issued by The National Historical Society, consisting of 32 chessmen crafted in solid pewter, brass and fine enamels.

I need send no money now. I will receive two chess pieces every *other* month, but will be billed for just *one* at a time—$17.50* per month—beginning when my first shipment is ready to be sent to me. I will also receive the pewter-finished chess board and fitted presentation case, at no added charge.

**Plus my state sales tax and 50¢ for shipping and handling.*

Signature ____________________
ALL APPLICATIONS ARE SUBJECT TO ACCEPTANCE.

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PLEASE PRINT CLEARLY

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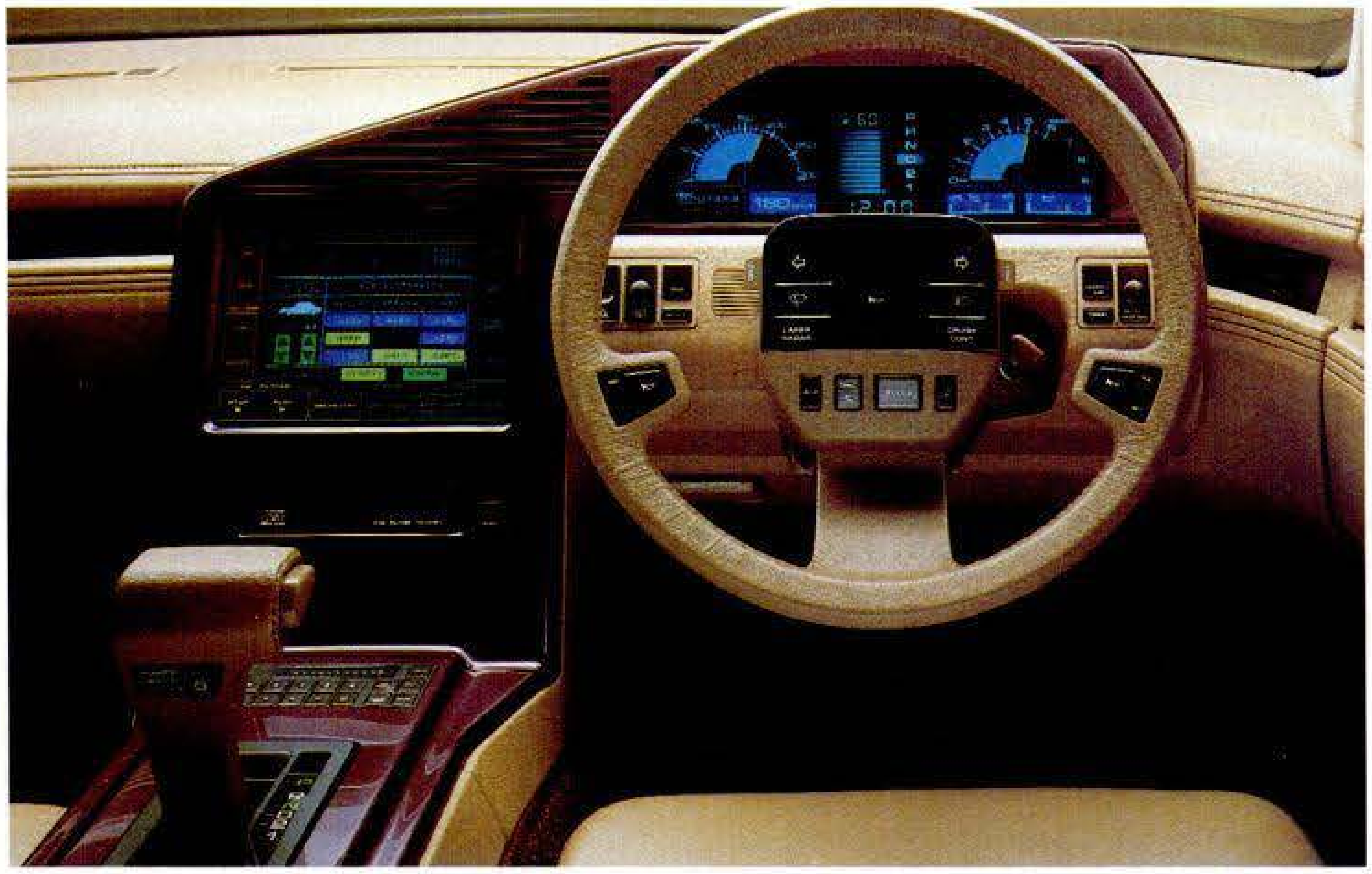
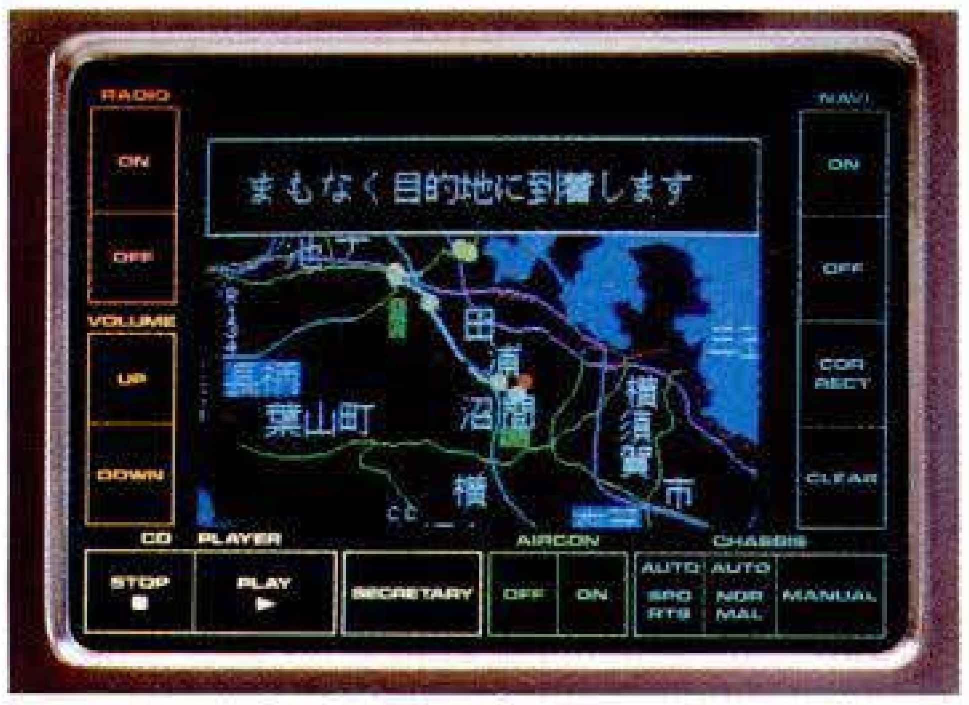
Automotive Newsfront





Techno-color dashboard

Critics have dubbed them "Tokyo by night" instrument panels in honor of that city's gaudy neon signs. But Nissan sees a bright future for multicolored electronic instruments. The panel of its CUE-X (above and left), shown at the Tokyo Motor Show, complements the usual liquid-crystal display with two CRTs that can be programmed to show performance information in bar graphs or pie charts. It also provides warning and service information.

In the center of the panel a touch screen displays maps and route guidance, which are calculated with the help of Global Positioning System satellites. The screen also controls the car's compact-disc player, air-conditioning system, and electronic air suspension. Sound far-fetched? Nissan assures us, "CUE-X is a working, active prototype for the next decade."

International affair

Designed in Germany, built in Korea, named after a French race, and sold in America, the 1988 Pontiac LeMans will be further proof that the automobile industry recognizes few borders. Opel will do the design and engineering of the subcompact, which will be based on the Opel Kadett currently sold in Europe. Korea's Daewoo will actually manufacture it. The car will be powered by a two-liter engine and will be available in at least two body styles: a hatchback and four-door sedan, as shown in the sketches below. The LeMans will go on sale in the fall of 1987.

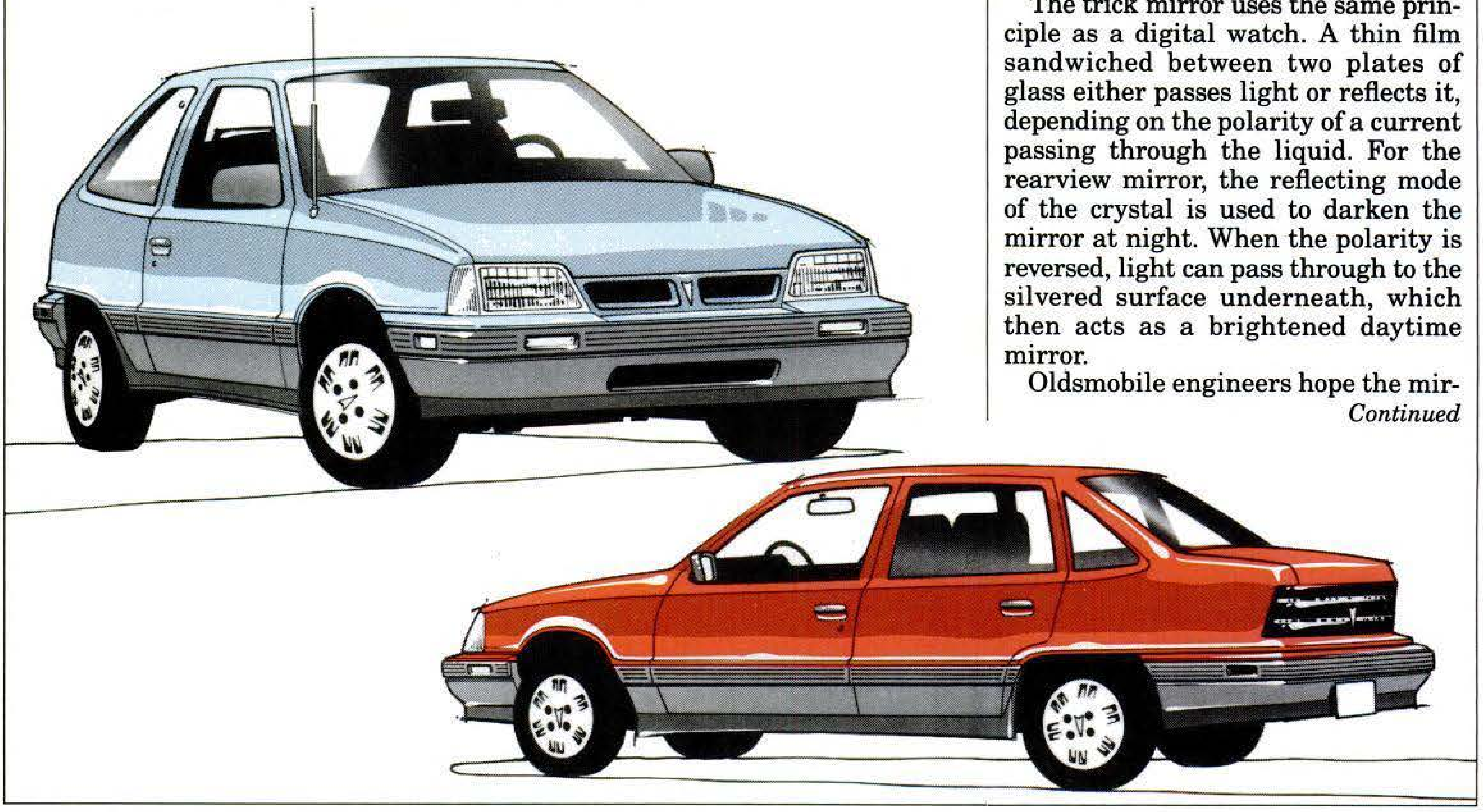
Watch your mirrors

Liquid-crystal technology is being developed to serve as a kind of electronic shutter for various applications, say engineers at Oldsmobile, who expect to have a liquid-crystal rearview mirror for the 1987 model year.

The trick mirror uses the same principle as a digital watch. A thin film sandwiched between two plates of glass either passes light or reflects it, depending on the polarity of a current passing through the liquid. For the rearview mirror, the reflecting mode of the crystal is used to darken the mirror at night. When the polarity is reversed, light can pass through to the silvered surface underneath, which then acts as a brightened daytime mirror.

Oldsmobile engineers hope the mir-

Continued



NISSAN INTRODUCES THE MOST IMPORTANT TRUCK ADVANCE IN 25 YEARS.

THE NEW HARD

FROM NISSAN—A TOTALLY NEW LINE OF TRUCKS Introducing a full line of trucks so tough, so powerful, so bold in styling, they could only be called Hardbodies. A revolutionary concept in compact truck design from Nissan, the company that invented the compact truck.

MORE POWER THAN EVER Totally re-engineered. A full line of fuel-injected trucks. With a re-geared powertrain that delivers more real power and torque to the rear wheels. Available with the biggest engine of any compact truck. Nissan's new 3.0 litre overhead cam V-6.

BODY NISSAN

BIGGER INSIDE Totally re-designed. Nissan created this new truck around its most important payload—you. With the biggest, broadest, roomiest cab in any Nissan.

BIGGER OUTSIDE Totally re-shaped. With hot-rolled steel wrapped around the longest, widest, most aerodynamic truck Nissan's ever built. And the biggest cargo box of all leading standard compact trucks. The Hardbodies. Bold. Taut. Muscular.

The Nissan SE King Cab® 4X4
Optional light bar, grille and brush guard shown here not available until April '86.

NISSAN—OUR MOST POWERFUL

EVERY TRUCK FUEL-INJECTED Regular Bed. Long Bed. King Cab.® 4X2. 4X4. The whole line fuel-injected for more power and performance. With a new 5-speed manual transmission standard throughout the line.

BIGGEST V-6 IN THE CLASS Workout the biggest engine in any compact truck ever—Nissan's new 3.0 litre overhead cam V-6. With 140 horsepower, no other compact pumps out more power. Or, choose Nissan's twin-spark, hemi-head 2.4 litre NAPS-Z engine. It's got the most power—106 horsepower—and torque of all the leading standard model compact trucks.

NEW FUNCTIONAL AERODYNAMICS Nissan knows that power alone doesn't make a truck great. It takes a truck designed with agility and finesse, too. Witness the new Nissan—the airfoil roofline, raked windshield, sloped hood and flared fenders. They weren't designed to make this Hardbody the sleekest, hottest-looking truck on the street—they're a function of aerodynamics designed to improve performance, reduce noise, and deliver a smoother ride.

Nissan SE King Cab 4X4 in Thunder Black

Standard Regular Bed 4X2 in bright red—
Nissan's lowest sticker-priced Hardbody

LINE OF COMPACT TRUCKS EVER

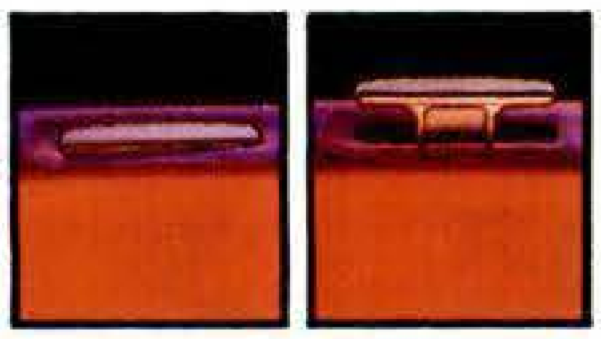
BUILT TOUGHER FROM THE GROUND UP Every Hardbody truck is built around a new, reinforced box-ladder chassis as tough as the steel from which it's cast—a chassis that handles a 1400 lb. payload on all the new E, XE, and SE models. A clean new underbody design—featuring a beefed-up independent front suspension—creates Nissan's best-ever ground clearance. And more galvanized steel is used in its underbody and sheet metal for even more rust resistance.

ONE-TON PAYLOAD For extra-big loads, Nissan's got an extra-big, extra-tough Hardbody—the new Heavy Duty Long Bed. V-6 powered, it's got an 88″ bed and a 2000 lb. payload.

Nissan XE Long Bed 4X4 in Platinum

NISSAN—OUR BIGGEST, WIDEST,

BIGGEST CARGO BOX Double walls of steel shape a cargo box so wide and deep, this new Nissan has the biggest cargo volume of any leading standard compact truck. It's wider, too, between the wheel wells, accommodating a wider track and bigger tires. Incredible attention was paid to even the smallest details. Case in point—the tie-down hooks. They're hidden—set into the cargo-side walls until you pop them out. These patented pop-up hooks are a Nissan exclusive, standard on all SE models.



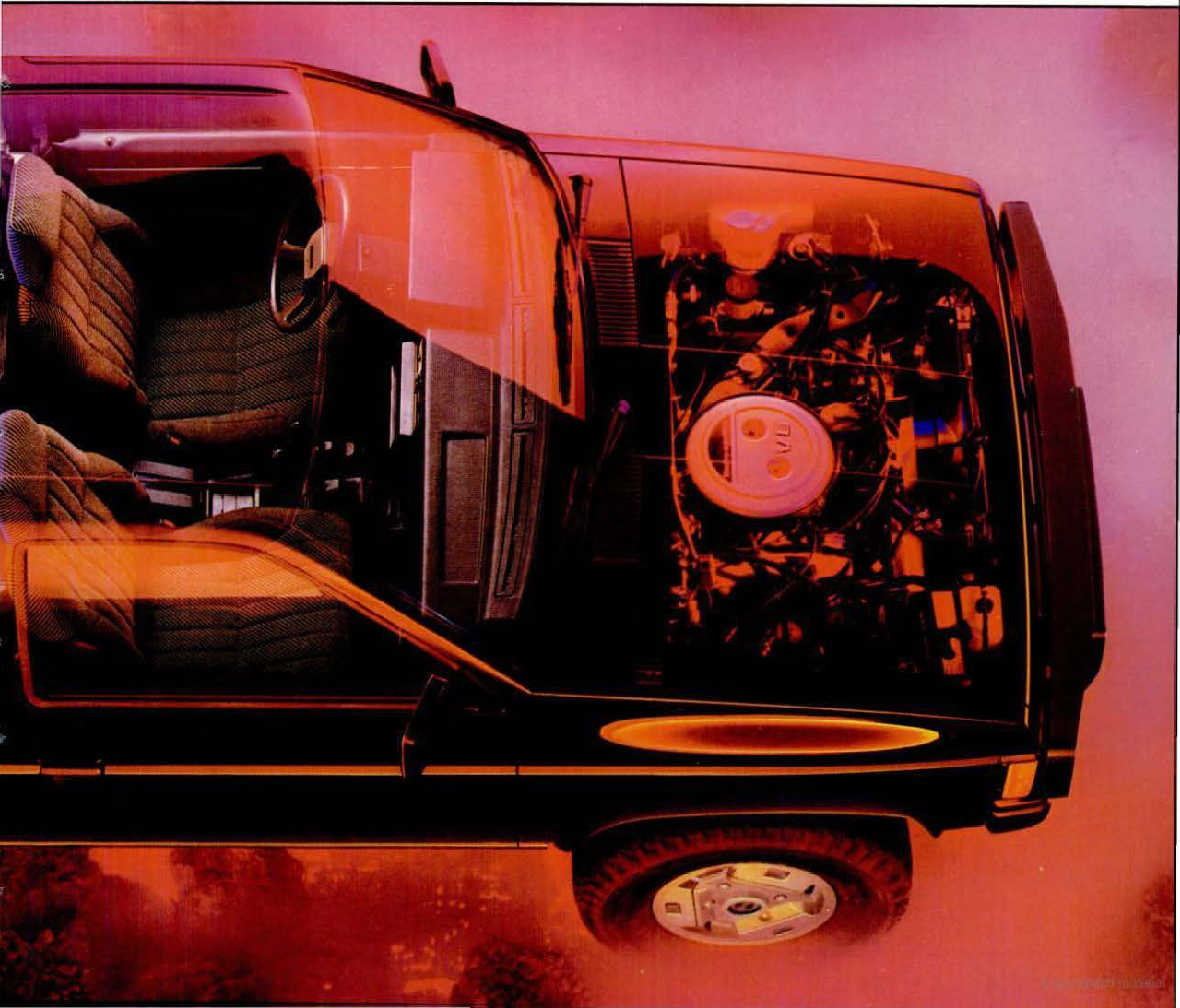
BIGGEST, FATTEST TIRES The biggest, widest (P235/75R15) factory-available tires of any compact truck are standard on the SE 4X4. If the biggest aren't big enough, trick-out the SE with Nissan's optional 31 X 10.5 R15's mounted on new alloy wheels. It's the hot set-up.

BIGGER KING CAB® America's best-selling extended-cab compact truck is now even better—and bigger. With more lockable space behind the buckets—for people or cargo. This new King Cab® introduces hideaway jump seats that fold flush into the side walls—another Nissan exclusive. And, new side windows wrap into the roof for extra visibility.

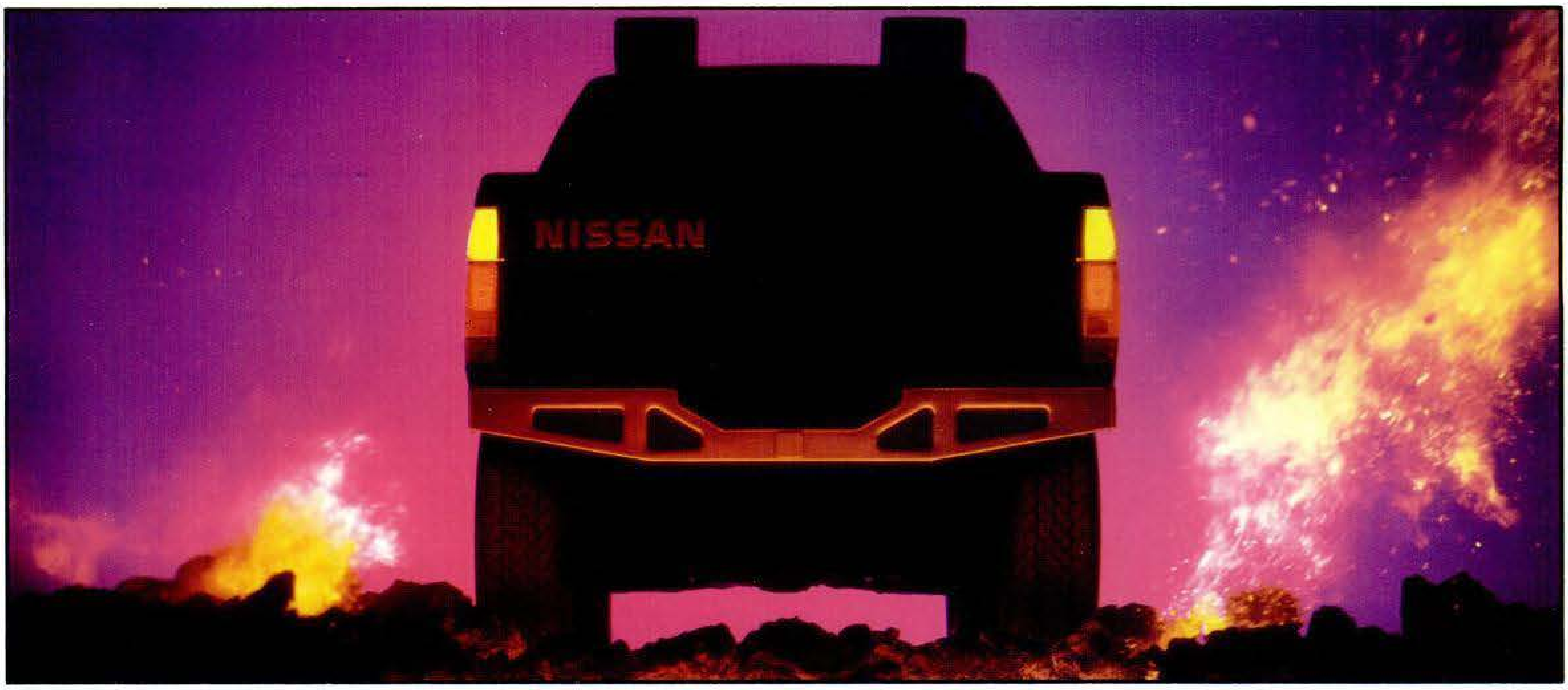
BIGGEST, ROOMIEST CAB— DESIGNED AROUND YOU Move into Nissan's biggest cab ever. Discover roominess head and shoulders above anything you ever expected in a compac truck. Look through the big side windows and huge windshield—the visibility is Nissan's best ever. New insulation and aerodynamics combine to dramatically reduce interior noise. Ventilation is improved, too. Nissan calls it ergonomics. You'll just call it intelligent. With full instrumentation laid out the way it should be. Easy to read. Easy to reach.

ROOMIEST TRUCKS EVER

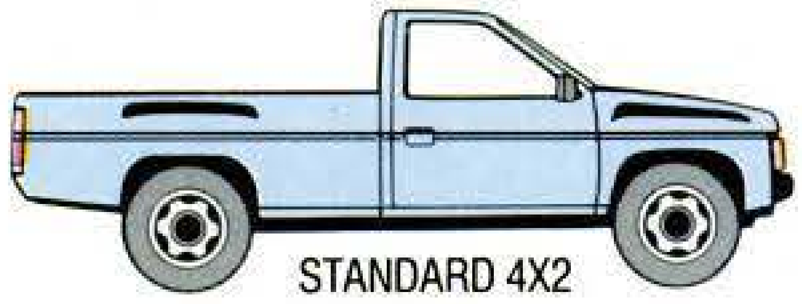
WIDE CHOICE OF OPTIONS There's a Hardbody truck for everybody. Regular Bed. Long Bed. King Cab.® 4X2. 4X4. The long list of options includes the only 4-speed overdrive automatic transmission in any compact truck. A big, new air conditioner. A Power Package (available with Sport Package) with power windows and doorlocks, cruise control, variable intermittent wipers, dual electric outside mirrors, and a superb AM/FM stereo cassette 4-speaker system. And the list goes on. Outfit a Hardbody truck any way you want—there will never be an ounce of fat on it.

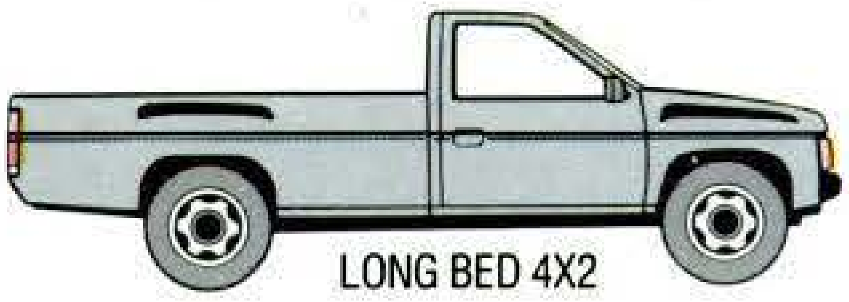


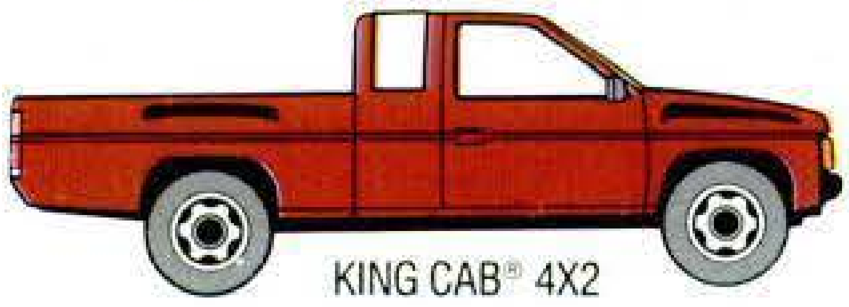
SPEC THE NISSAN HARDBODIES

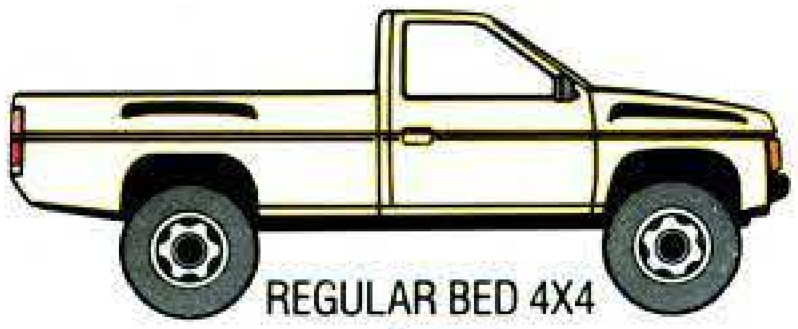


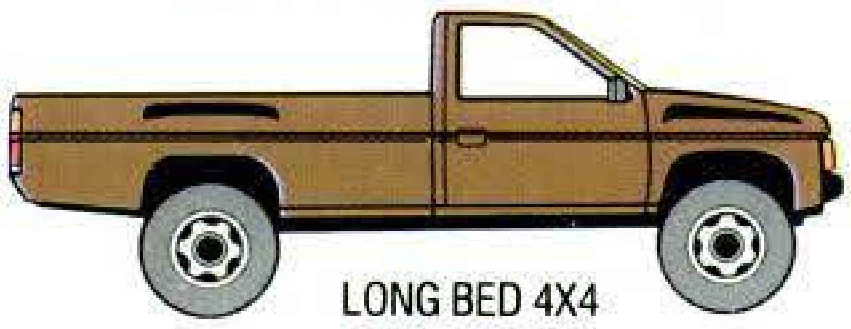
They're built tougher. Play rougher. Look hotter. They're Hardbodies. There's never been a line of trucks in better condition.

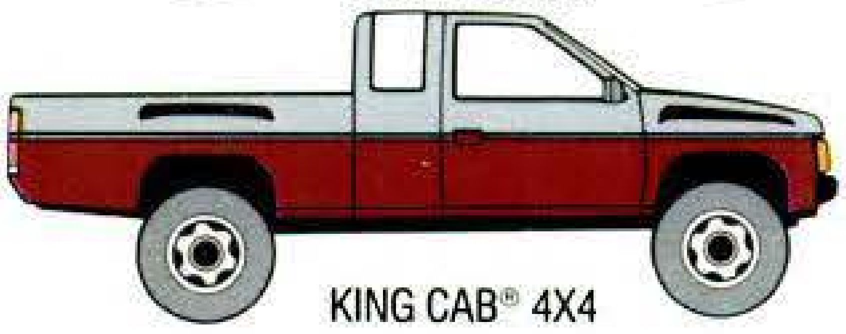

STANDARD 4X2


LONG BED 4X2


KING CAB® 4X2


REGULAR BED 4X4


LONG BED 4X4


KING CAB® 4X4

NISSAN TRUCKS DIMENSIONS AND WEIGHTS	**REGULAR BED**	**LONG BED**	**KING CAB®**	**REGULAR BED**	**LONG BED**	**KING CAB®**
		4X2			4X4	
Wheelbase (in.)	104.3	116.1	116.1	104.3	116.1	116.1
Length Overall (in.)	174.6	190.0	190.0	174.6	190.0	190.0
Width (in.)	65.0	65.0	65.0	66.5	66.5	66.5
Height (in.)	62.0	62.0	62.0	66.7	66.7	66.7
Track—Front (in.)	54.9	54.9	54.9	56.1	56.1	56.1
Track—Rear (in.)	54.5	54.5	54.5	54.5	54.5	54.5
Headroom—(in.)	39.3	39.3	39.3	39.3	39.3	39.3
Legroom—(in.)	42.2	42.2	42.6	42.2	42.2	42.6
Shoulder Room (in.)	55.3	55.3	55.3	55.3	55.3	55.3
Payload (lb.)[1]	1400[2]	1400	1400	1400	1400	1400
Bed Length (in.)	72.6	88.0	73.4	72.6	88.0	73.4
Bed Width (in.)	59.8	59.8	59.8	59.8	59.8	59.8
(Between Wheel Wells)	41.7	41.7	41.7	41.7	41.7	41.7
Bed Depth (in.)	17.1	17.1	17.1	17.1	17.1	17.1
Transmission (std.)	M50D[3]	M50D	M50D	M50D	M50D	M50D
Transmission (opt.)	A40D[4]	A40D	A40D	N/A	N/A	N/A
NISSAN TRUCK ENGINES	**2.4L I-4**			**3.0L V-6**		
Displacement (cc)	2389			2960		
Horsepower @ rpm	106 @ 4800			140 @ 4800		
Torque (ft. lbs.) @ rpm	137 @ 2400			166 @ 2800		
Induction System	Single Point Fuel-Injection			Single Point Fuel-Injection		

[1] Heavy-Duty Payload Available 2000 lbs. [2] Regular Bed Standard Payload 1000 lbs. [3] Manual 5-Speed Overdrive. [4] Automatic 4-Speed Overdrive.

Nissan trucks are available with a wide choice of trim levels (STD, E, XE, and SE), exterior colors (11—including 3 great new two-tones), and interior colors (4—including a new dark red).

BELT YOURSELF

NISSAN NISSAN

THE NAME IS
NISSAN

ror is only the beginning. A sun roof and even side windows that can be electronically darkened are under development. Privacy seekers will have to wait for a while, though, as problems with a patchy effect in the darkened glass haven't been licked yet.

Mazda or Mustang?

A sporty Mazda coupe (above) was recently spotted undergoing tests on this side of the Pacific. Will this be the new Mazda 626, or could it be the future Ford Mustang? The two-door is based on the 626, and features aerodynamic headlights, flared fenders, and a wraparound rear window. Under the skin is a turbocharged four-cylinder engine and anti-lock brake system.

Ford has said it will buy cars built by Mazda at its Flat Rock, Mich., plant. The familiar long hood and short deck of the car pictured could mean that a Mustang nameplate will find its home on the trunk lid.

Three into six

Multiple-valve arrangements are all the rage these days, as the quest for higher horsepower has prompted a raft of new engines featuring four valves per cylinder. Now Pontiac is trying another approach: an engine with three valves per cylinder. The prototype 3.2-liter V6, which produces some 200 hp, is only one of the half dozen high-output engines under study.

Turning to Germany

A limited number of Pontiac Fieros will be built this spring with a new five-speed transaxle made under license from Getrag Gears A.G., the West German transmission company that currently sells to Mercedes, BMW, and others. The 170-ft.-lb. torque rating of the transaxle allows it to be used with the 2.8-liter high-output V6. Up to now, General Motors hasn't had a five-speed capable of handling the torque of a transversely mounted high-performance engine.

Chrysler has also turned to Getrag for new transmissions, and the company will use Getrag-built and -based units in its high-horsepower cars starting in 1987. In addition to the higher torque ratings, the Getrag transaxles feature changes in bearing design to improve the balky shifting found on many domestically built transaxles.

Shift by chip

Electronics may soon make another major inroad on the domestic automotive scene. Both Chrysler and General Motors are developing a new generation of electronically controlled automatic transmissions for their 1990 front-drives. These four-speeds use computer-controlled shift valves, which initiate shifts based on electronically sensed engine speed, vehicle speed, ambient temperature, engine temperature, and throttle position. Although there has been a lot of discussion lately about continuously variable transmissions, these electronically controlled transmissions are regarded as the next level in transmission design, especially for larger vehicles with higher horsepower requirements.

Wide-track Alfa

Engineers at Pontiac and Italy's Alfa Romeo are discussing joint development of a small sporty car. Talks have been centering on a four-place subcompact similar to the current Alfa GT. Along with the car, expect some business link between General Motors and Alfa.

Manufacturing revolution

Revolutionary changes in auto manufacturing are anticipated by the mid-1990s, as evidenced by some top-secret work being conducted by General Motors to study methods for assembling future cars. Studies at the Buick-Oldsmobile-Cadillac (BOC) group are looking at highly automated assembly of conventional steel bodies and at high-volume production of cars built with a metal skeleton and hang-on plastic skin. Also under study are all-plastic cars. This concept was demonstrated by the Buick Wildcat show car ["ANF," PS, Feb.]. Word at GM is that when the three studies are completed, results will be used to pick the most promising way to build future BOC cars.

Cutting engine costs

Along with changes in the way cars are assembled, General Motors expects to radically alter the structure of its basic four-cylinder engines to make them easier (and cheaper) to manufacture. Melodramatically dubbed the Manhattan Project—after the World War II project that developed the atomic bomb—the new engine will have an aluminum block and head cast in a single piece.

It's not a new idea—the Rolls-Royce Merlin aero engine used integral cylinder heads—but it's one that hasn't seen much use in passenger cars since the 1920s. The 1990 Camaro and Firebird were supposed to get the Manhattan Project engine at the same time they were switched to front-wheel drive. But GM insiders say the engine probably won't be ready in time.

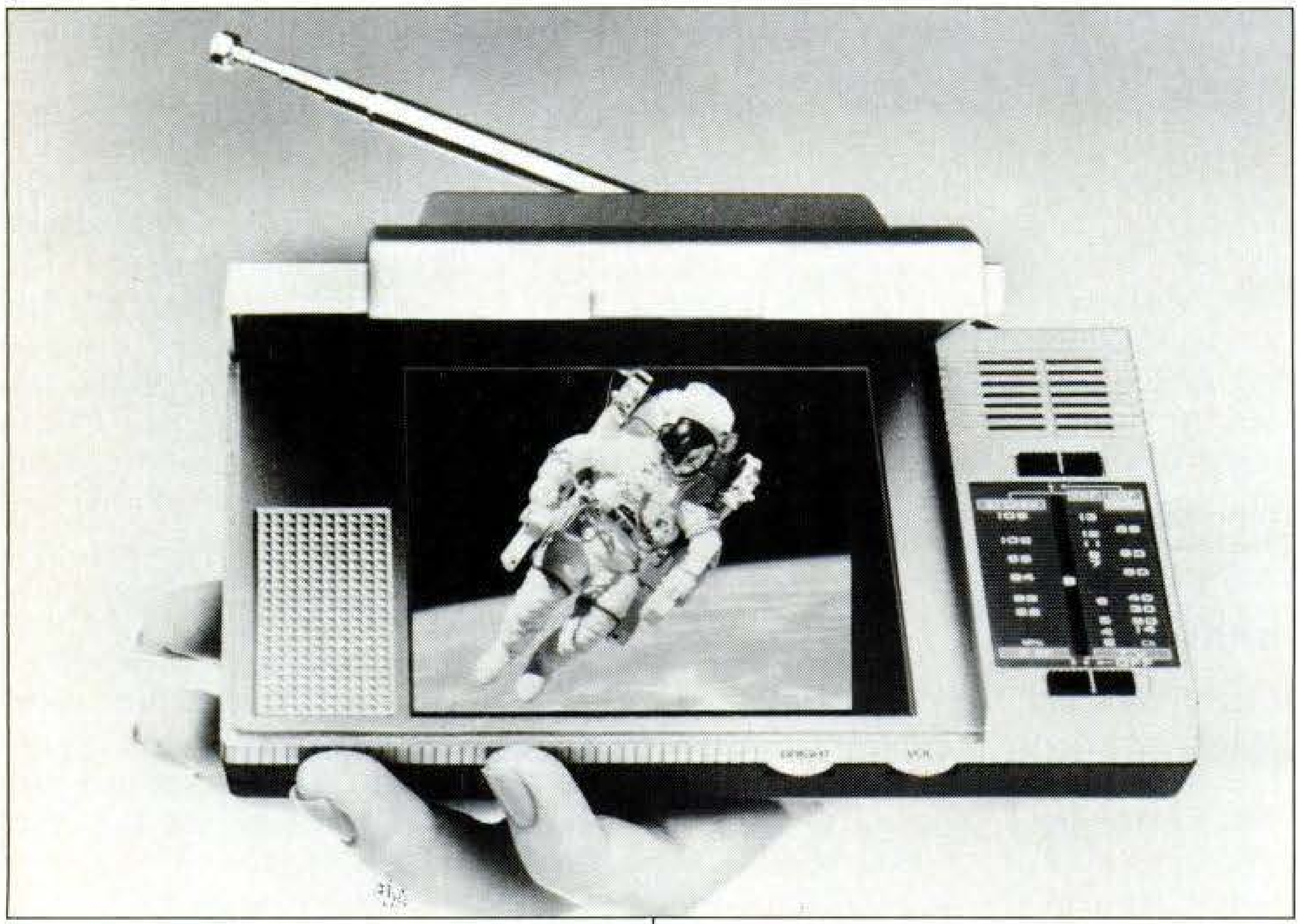
News briefs

- Chevrolet has a computer program that lets buyers select a car or light truck, pick options, total up the price, and explore financing before they even set foot in a showroom. It could be a secret weapon for dealing with the dealer. The disk is available for the IBM PC, Apple IIe, and Commodore 64. Cost is $3 from ChevyTech, Box 2054, Warren, Mich. 48090-2054.
- Four valves good, six valves better? Maserati is reported to be working on a V6 with six valves per cylinder—three intake and three exhaust. One cam lobe operates each trio of valves via a trident-shaped rocker arm.
- Buyers who are disappointed because their new car uses more fuel than the old one should be patient. Saab says it may take a new engine 6,000 miles to break in. The economy difference can be up to 10 percent.
- Finally, for some cheap thrills, consider the Desta. The $5,499 convertible, built in Greece, will go on sale here this spring, says the importer, Brooke Weisleder of Bricktown, N.J.

Contributors: Jack Keebler (New York), Dan McCosh (Detroit), Jim Schefter (West Coast), David Scott (Europe), Tom Wilkinson (New York)

Electronics Newsfront

By WILLIAM J. HAWKINS

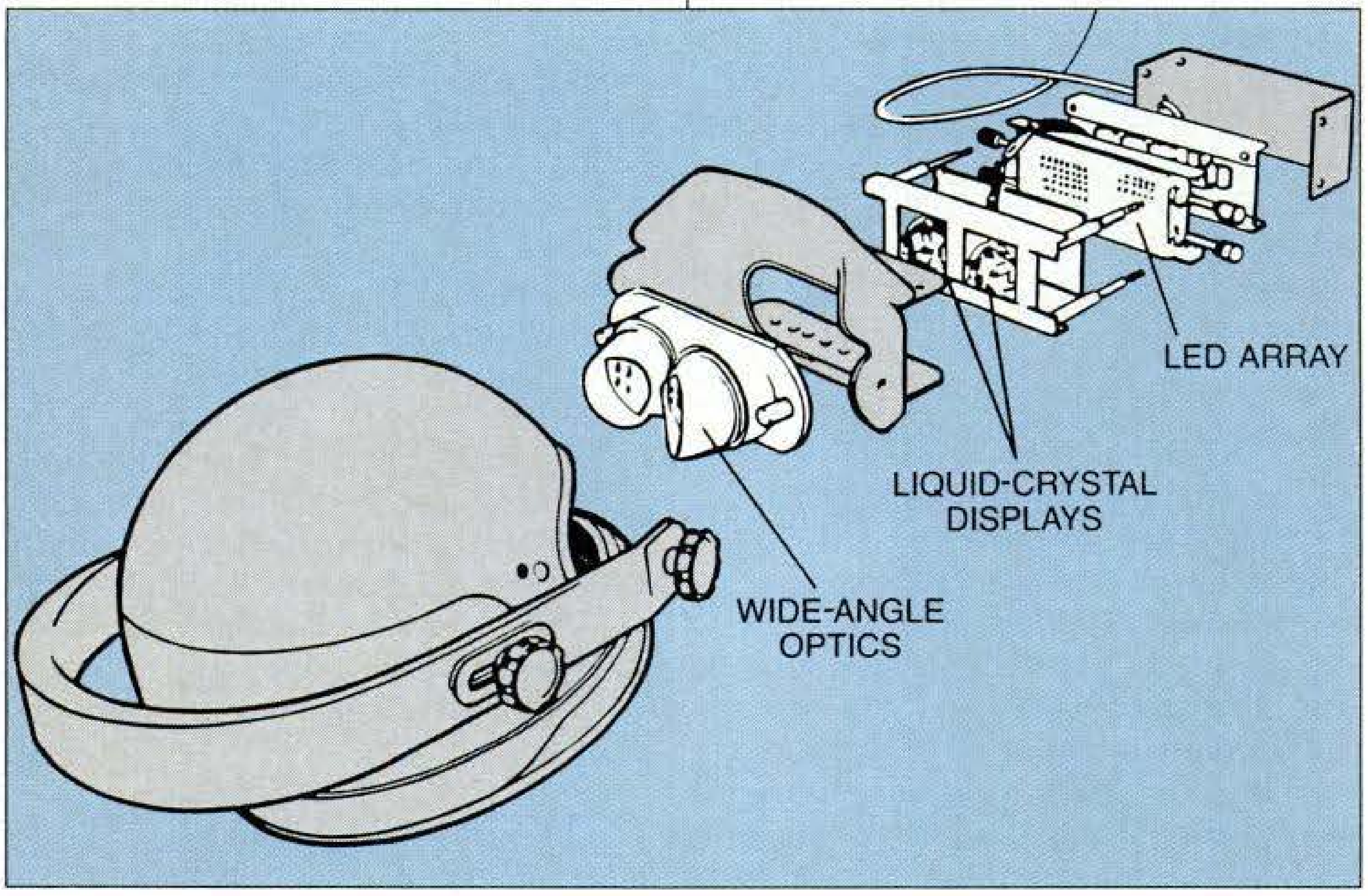


Show stoppers

Manufacturers exhibit their latest electronic marvels at The Consumer Electronics Show. Senior Editor John Free, just returned from the show, reports on some highlights:

Pocket TVs mushroom. Pocket-size TV sets are hot. Panasonic rolled out its first LCD set, a three-inch $299 color model available in May. Panasonic's enhanced-resolution color display, based on the black-matrix principle used in picture tubes for better contrast, easily surpasses the image quality of other LCD sets on the market. And Citizen Electronics introduced its shirt-pocket-size $99 06TA black-and-white LCD set with a 2.5-inch screen, plus the $159 08TA (above) with stereo FM.

Citizen claims its new method of making LCD panels will result in tiny sets priced at less than $50 and 12-inch models costing less than $400 by 1990. "You'll be seeing models built into toy bears," predicts marketing director John Witt. Citizen's latest black-matrix models offer higher resolution and perceptibly better images compared with earlier LCD models on the market.



NASA's 3-D video helmet. "They're sort of the ultimate Foster Grants," quipped NASA engineer Jim Humphries as he demonstrated flip-up goggles for a prototype space helmet. Like sunglasses, NASA's new helmet could filter sunlight. But its real job is displaying computer information to pilots or astronauts.

The helmet (below), built for about $2,000 at NASA's Ames Research Center, in California, has two TV screens plucked from ordinary Citizen LCD pocket-size sets. Three-dimensional computer-graphics images transmitted to the helmets may aid pilots of advanced jet aircraft or persons working on upcoming space stations. With a transparent-screen version, for example, computer-generated diagrams could be superimposed over the actual view of a space station as it's assembled. A helmet sensor detects head movement, so computer images change and "track" when you look in another direction.

I peered through a pair of goggles that displayed WELCOME TO NASA, produced by a small character generator. Special lenses are designed to visually immerse you in a scene; the wraparound view is akin to a front-row seat at a 3-D cinemascope movie. The NASA team is quickly adapting higher-resolution and color-LCD screens.

Videodiscs: higher-fi, 3-D. Rock-video images on color monitors at Yamaha's booth seemed especially crisp and clear. That's because the firm's new videodisc players, the LV-X1 and LV-X1 Digital, offer exceptional horizontal resolution—up to 400 lines. The digital model also decodes digitized audio now on some videodiscs; until now that required a combination videodisc and CD machine.

Meanwhile, in Japan, several firms are readying players and discs that deliver either high-definition TV (1,250 scanning lines) or 3-D. Victor Co. of Japan (JVC here) will market 3-D videodiscs, adapters, and special LCD glasses overseas this year. Victor's 3-D system is based on capacitance-type VHD-disc hardware, not yet on the U.S. consumer market. (LaserVision discs with 3-D have also been demonstrated.) The high-definition TV discs deliver about half the playing time of standard-TV versions. Unfortunately for video buffs, no marketing plans have been announced.

Continued

ESCORT
HIGHWAY
CITY
VOLUME
RADAR WARNING RECEIVER
ALERT

It's Unanimous

(Even the competition says ESCORT's the one to beat)

It's easy to see who sets the pace in radar warning. Just read all the detector ads. Most of them claim to be as good as ESCORT. A few say they're better.

At least they agree on one thing. ESCORT is the one they have to measure up to.

A modern classic

ESCORT was a radical piece of electronic engineering in 1978 when it was introduced, the first practical use of superheterodyne technology to warn of police radar. *Car and Driver* magazine said, **"...the radar detector concept has finally lived up to its promise."**

Since then, our engineers have never stopped refining that technology. ESCORT may look the same on the outside, but it never stops getting better on the inside.

Standard of comparison

Now, when experts refer to the high-water mark in radar protection, they automatically turn to ESCORT. In March of this year, *Car and Driver* published its latest detector test, this one comparing remote-mounted models. ESCORT is designed for dashtop or visor mounting. But the magazine included ESCORT in the test anyway, as the reference against which the performance of the others would be measured. ESCORT scored 412 points in the final rating, compared to 274 for the highest-finishing remote. You might say the comparison showed that there is no comparison.

A gilt-edged reputation

Seven years is a long time in the radar warning business, but there is no shortcut to a good reputation. *Car and Driver* said, **"The ESCORT radar detector is clearly the leader in the field in value, customer service, and performance..."**

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These excerpts were taken entirely from advertisements for other radar detectors.

So it's easy to understand why other detectors would try to stand in our limelight. ESCORT has seven years worth of credibility, the one quality that money can't buy in this business.

Check our references

Credibility doesn't come from extravagant claims. It comes from satisfying customers. You probably know someone who owns an ESCORT (nearly a million have been sold). So ask about us.

ESCORT pioneered superheterodyne receiving circuitry. Ask if our radar warnings always come in time.

ESCORT's reporting system combines an alert lamp, a variable-rate beeper that distinguishes between X and K band, and an analog meter, all to give an instant indication of radar strength. Ask if our warning takes the panic out of radar.

ESCORT is sold in one place only, the factory that makes it. This lets you deal directly with experts. Any of our staff of over 60 sales people will be glad to answer any questions you may have, about ESCORT or about radar in general.

We've been solving people's radar problems since 1978. How can we help you?

Try ESCORT at no risk

Take the first 30 days with ESCORT as a test. If you're not completely satisfied return it for a full refund. You can't lose.

ESCORT is also backed with a one year warranty on both parts and labor.

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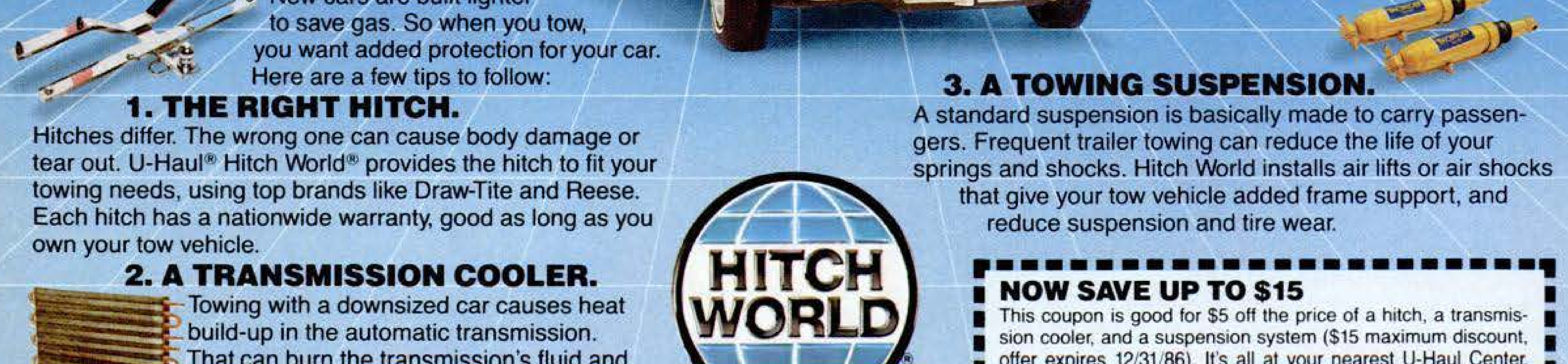
Price busters

It accepts a sheet of paper like a photocopy machine. But a page scanner converts the image to bits and bytes for use in a personal computer. Until now, automatic scanners cost about $5,000; the PC Scan (right), from Dest Corp. (1201 Cadillac Ct., Milpitas, Calif. 95035), is $1,995. With a $595 Text Pac program, graphic images that contain text—pre-typed characters and numbers—can be edited directly by a computer's word processor.

QMS (1 Magnum Pass, Mobile, Ala. 36618) has introduced a new six-page-per-minute laser printer called KISS. The real love affair is with its price: $1,995, one third the cost of most other laser printers.

Quick looks

- Write-once laser-disc drives for personal computers have arrived: Among the first companies to introduce one is Portable Solutions (Austin, Texas). Designed for the IBM PC/AT and compatibles, the 100-megabyte removable-disc system is about $5,000; discs, less than $200.
- A complete CD-ROM package, consisting of the Grolier's Encyclopedia on a CD, drive, controller, and retrieval software, is now available for the PC from Activenture Corp. (Box 51125, Pacific Grove, Calif. 93950). It's $1,000. A similar package for the Apple IIe is $1,995 from Micro-TRENDS (650 Woodfield Dr., Schaumburg, Ill. 60195). It includes 512K of RAM and a 68000 microprocessor.
- Touch that keyboard, and it may cost you $18,400. But the good news is that you now own a Nissan 300ZX. Viewdata (1111 Lincoln Rd., Miami Beach, Fla. 33139) has gone national and is now offering BidQuik—an online auction service—to its computer subscribers, and the next round of bids is on the sports car. Too afraid of "winning" to try? Then enter YGI—You Guessed It—on CompuServe (5000 Arlington Centre Blvd., Columbus, Ohio 43220). Sponsored by Hallmark Cards, the game lets you play with others as a team to guess trivia questions. Win, and you get points towards a prize.
- From the cheers and boos department: Timothy Schabeck wrote the book *Managing Microcomputer Security*. It tells how large companies can protect valuable computer data from being lost or destroyed, and the book has been an instant sellout. Cheers. But there was only one customer: the Internal Revenue Service.



How to Tow With Today's Car and save up to $15 at U-Haul

New cars are built lighter to save gas. So when you tow, you want added protection for your car. Here are a few tips to follow:

1. THE RIGHT HITCH.
Hitches differ. The wrong one can cause body damage or tear out. U-Haul® Hitch World® provides the hitch to fit your towing needs, using top brands like Draw-Tite and Reese. Each hitch has a nationwide warranty, good as long as you own your tow vehicle.

2. A TRANSMISSION COOLER.
Towing with a downsized car causes heat build-up in the automatic transmission. That can burn the transmission's fluid and shorten its life. Hitch World selects and installs a transmission cooler, like Hayden, that extends the transmission's life by releasing the towing-caused heat.

3. A TOWING SUSPENSION.
A standard suspension is basically made to carry passengers. Frequent trailer towing can reduce the life of your springs and shocks. Hitch World installs air lifts or air shocks that give your tow vehicle added frame support, and reduce suspension and tire wear.

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This coupon is good for $5 off the price of a hitch, a transmission cooler, and a suspension system ($15 maximum discount, offer expires 12/31/86). It's all at your nearest U-Haul Center. Look in the White Pages under U-Haul. Write for a FREE HITCH GUIDE: HITCH WORLD, Dept PS, P.O. Box 21503, Phoenix, AZ 85036 Limit one coupon per customer. PS486

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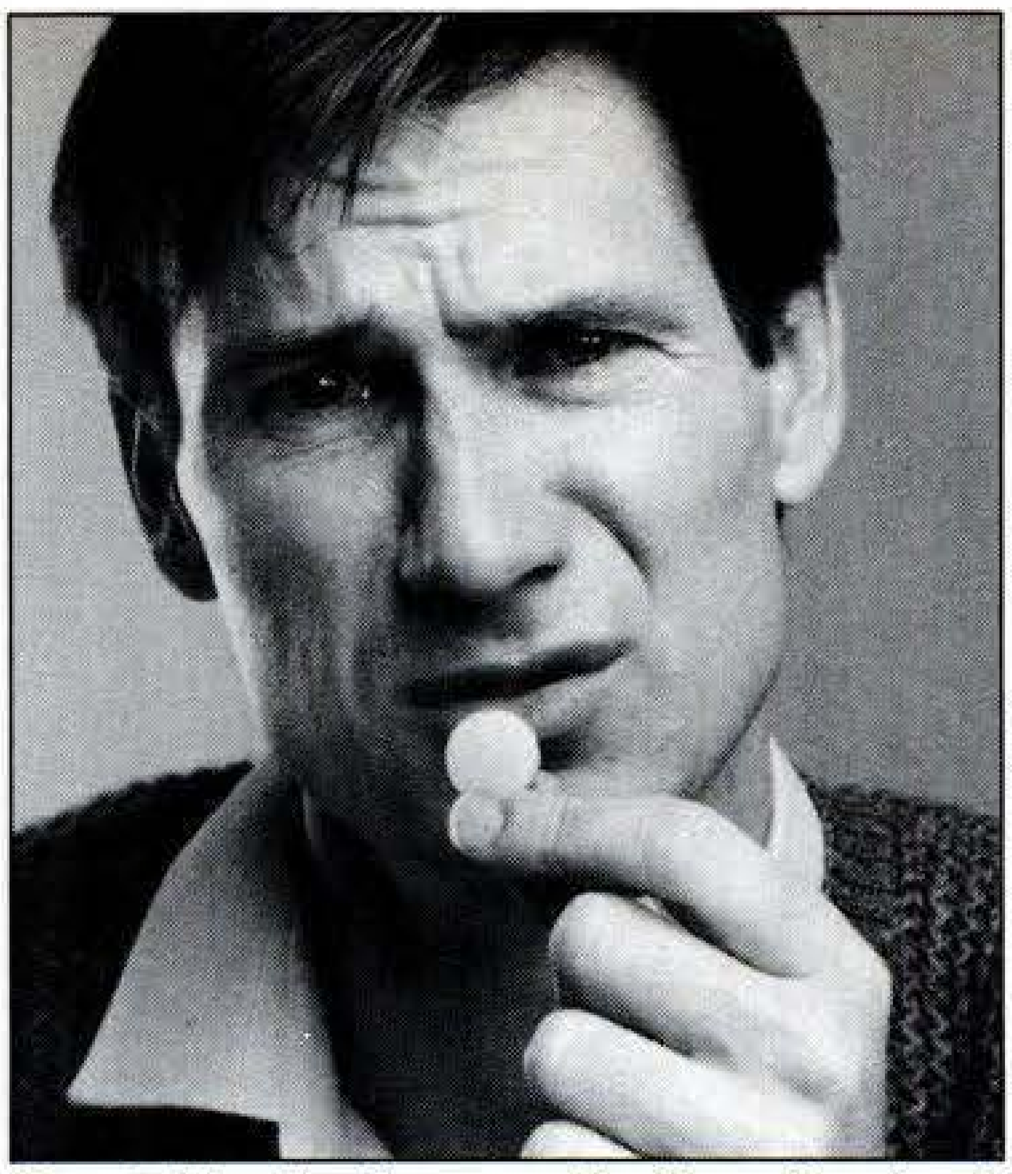
Stop Taking Vitamins

If you think the vitamins you are now taking are doing you any good, wait until you hear the latest news on why they may not.

By Joseph Sugarman



Stop taking that innocent looking vitamin pill until you read this report.

This may come as a shock. But according to the latest research, those vitamins that you take every day may be doing you absolutely no good. For example.

FACT: Vitamins should be taken after a meal—never before. The body must first have protein, fats, or carbohydrates in the digestive tract to properly break down the vitamins for proper absorption.

FACT: Your body has a need for a natural vitamin balance. Too much of one vitamin may cause another vitamin to be less effective. For example, vitamin A should be taken with Vitamin E but excessive iron should not.

FACT: If you take too much calcium, you may deplete the magnesium in your system. And you need magnesium to convert food into energy.

FACT: Some vitamins are best taken in the morning and others at night. For example, the trace element chromium helps break down the sugar in your food which in turn creates energy—perfect to start the day. But at night you should take Calcium which has a relaxing effect—perfect for the evening.

FACT: Athletes or people who exercise a great deal need vitamins more than people who don't exercise. Vitamins are depleted at a much faster rate during exercise than during any other period of time.

But there was a series of other facts that surprised me too. For example, despite everything I've just mentioned on the care in taking vitamins, there are those people who absolutely need vitamins because of the mental or physical activity that they undergo. People on a diet, under stress, those who smoke, women who take contraceptives and even those who take medication—all rob their bodies of some of the essential vitamins and minerals that they need to help combat the various habits or conditions they are under.

And with proper vitamins in the proper balance and at the proper times, you will have more energy and vitality. Little changes may take place. Your nails may become stronger, your hair may become thicker and your skin may be more elastic which will keep you younger-looking longer.

DOCTORS HAD IDEA

About two years ago a group of doctors had an idea. They realized that many people were taking vitamins and not really noticing any difference in their health. They also realized that, based on the latest nutritional findings, the vitamins people were taking may not have been doing them any good. So they formed a group of advisors consisting of nutritionists, dieticians, dermatologists, biochemists and physicians, and they worked on the development of a vitamin program that incorporated all of the latest information on vitamins, minerals, nutrition, food processing—even stress research. They realized that vitamins were a two-edged sword. They could either help you or hurt you.

They then took all this information and developed the most effective combination of vitamins and minerals, formulated four tablets—one for the morning and one for the evening—and one for men and one for women and then started a test program that lasted over two years. The results speak for themselves.

It was perfect for weight loss programs and it was perfect for people under stress. It helped many increase their energy levels. Smokers benefited. Some under medication benefited. And before long the company that had developed the program became the fastest growing vitamin company in the United States. And no wonder.

SEVERAL BENEFITS

With the proper vitamin and mineral balance, taken in the right quantity in the right combination and at the right time, several obvious benefits occur. First, you may develop a better mental outlook because you've got the energy and the zest to accomplish more. As a result of the trace elements copper, zinc and manganese, your body is helped to make its natural anti-aging enzymes that keep you fit. Improvements in your vitality translate into everything from better job performance to a more fulfilling sex life.

JS&A has been selected by the vitamin company to introduce their medically formulated vitamin program. Every two months we send you a two month's supply of 120 fitness tablets—one to be taken after breakfast and one after dinner.

During the first two months, you will have ample opportunity to notice the difference in your energy level, your mental attitude and your overall stamina. You should notice little things too, like the strength of your fingernails, your thicker hair. Your complexion may even take on a glow. Some of you may notice all of these changes and others may notice just a few. But you should notice a change.

IF YOU NOTICE

If for any reason, you do not notice the change, no problem. Just pick up your phone, and tell us not to send you any more vitamins. You won't have to mail the empty bottle back to us, fill out a long survey or waste another penny. Just pick up the phone and we'll give you a full refund for the entire bottle without ever getting the bottle back from you. However, if you indeed do notice a difference (which we are confident you will), you'll automatically receive a two-month's supply every eight weeks.

Not only is this offer risk-free, but we're going to give you one more incentive just to let me prove to you how powerful this program really is. I will send you a bonus gift of a fitness bag with your first order. This beautiful bag will hold all your fitness gear and it's great too for short vacation trips. It's a $25 value but it's yours free for just trying the vitamins. Even if you decide not to continue, you keep the fitness bag and the vitamins. I am just so absolutely convinced that you will feel and see a difference when you take these vitamins, I am willing to bet on it with this unusual offer.

Vitamins indeed are important. And with today's research and new nutrition technology, you have a greater chance to achieve the fitness and health levels that may have eluded you with the typical store vitamins or the often poor advice we may get in health food stores or from friends or relatives. Here is a safe, risk-free way to get one of the best vitamin programs in the country, formulated by a physician, with the right combination of vitamins, minerals and trace elements, in a convenient program that assures you of delivery every two months. I personally take them and have for the past several months and highly recommend them. Order your trial quantity, today.

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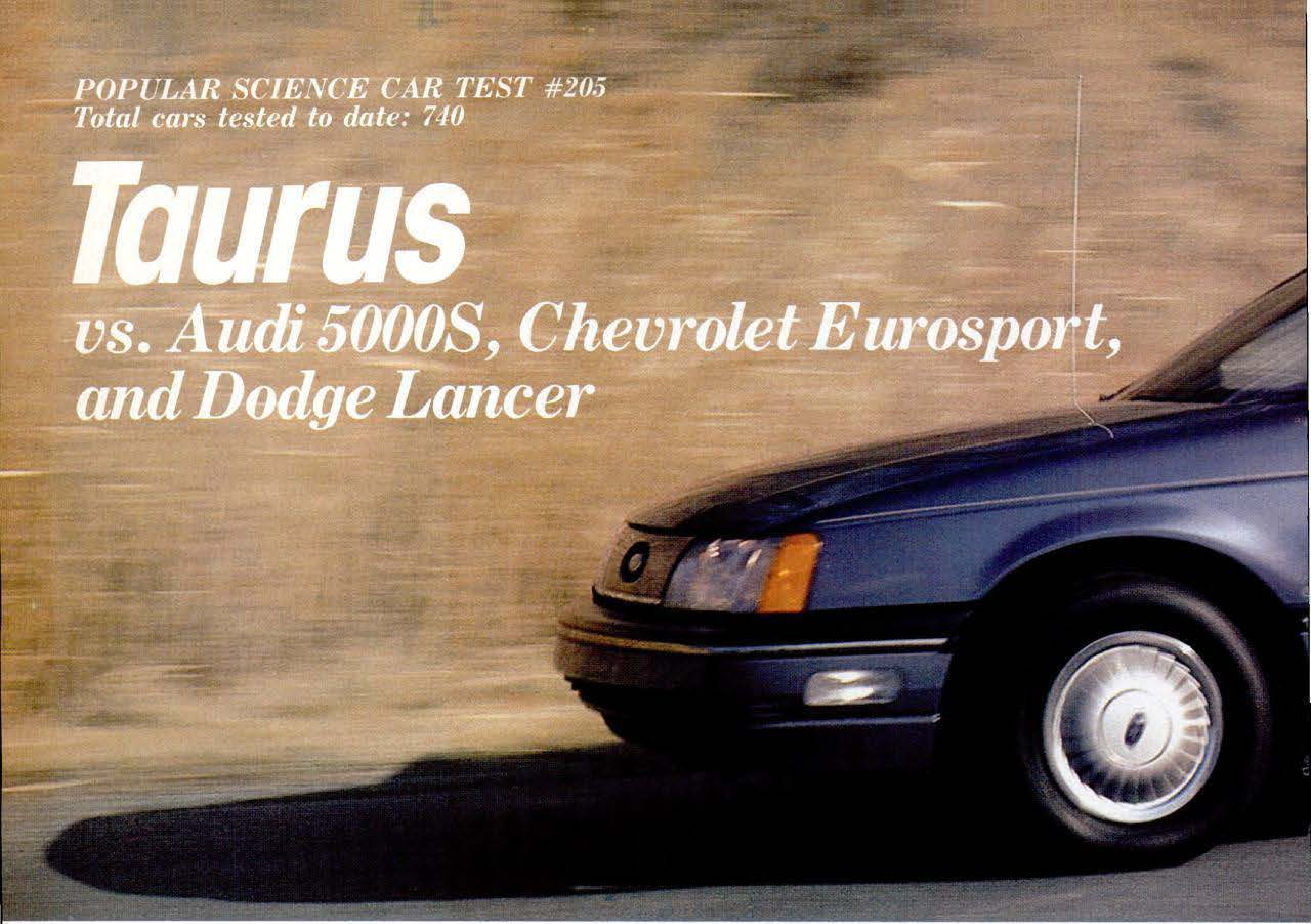
POPULAR SCIENCE CAR TEST #205
Total cars tested to date: 740

Taurus

vs. Audi 5000S, Chevrolet Eurosport, and Dodge Lancer



With its all-new power train and smooth aerodynamic shape, Ford Taurus has the makings of a world-class car. The PS road test reveals how well Taurus performs against the Audi 5000S, Chevrolet Eurosport, and Dodge Lancer.

By TOM WILKINSON
and JACK KEEBLER
Photos by Greg Sharko

From our first day with the Ford Taurus LX, we knew it was an attention getter. Wherever we parked, someone was always admiring it when we returned. And wherever our testers drove it, they were constantly asked, How do you like it?

Is Taurus more than a pretty face? To find out, we pitted it against a trio of its competitors: Chevrolet Celebrity Eurosport, Dodge Lancer ES, and Audi 5000S. We selected the Audi because many consider it to be a bench mark for high-performance sedans. But our test revealed no performance area in which the Audi was clearly superior. In fact, the performance gap between European and domestic sedans appears to be shrinking, if not disappearing altogether. When we had finished our tests, we came to a split decision over which car was the champion of this group. Surprisingly, the choice was between two of the domestic models.

For a sedan with ample room for four large adults, Taurus performs well. In our acceleration test, the three-liter V6 and four-speed automatic transaxle powered the sedan to 60 mph in an impressive 11.8 seconds. And at highway speed, the car reflected Ford's experience building two-ton prairie cruisers by whispering along at a quiet 66 dBA as measured on our sound meter.

The Taurus also did well in our handling and maneuverability tests, even though it was equipped with Firestone Supreme all-season radials that were never intended to provide ultimate traction on dry pavement. High-speed passes through the handling test were marked by prodigious amounts of four-wheel drift. During several passes the back end swung wide, requiring quick chops of the steering wheel to regain control. The soft springs allow a fair amount of body roll, but the independent front and rear suspensions (see sidebar) keep the tires planted firmly on the pavement, even when cornering on rough roads. And in spite of the soft ride, the Ford didn't float or wallow like many domestic sedans.

Only in the braking lane did the Taurus disappoint. Our first stop from 60 mph with cold brakes was an unimpressive 175 feet. And during the 10 stops from 60 mph that we use to warm the brakes before our hot-braking test, pedal pressure rose and the front brake pads started to smoke. The final hot stop was 180 feet, indicating that the brakes did retain what stopping power they had. Still, we expected better braking from a newly designed car.

We asked Ford about the brakes. "We have been getting stopping distances of around a hundred forty-eight feet for the Taurus sedan," said a Ford brake-development engineer. "I would say that the linings could still have been green [not broken in]."

Brake smoke is usually the burning off of volatile compounds in new brake pads, he said. When this hap-

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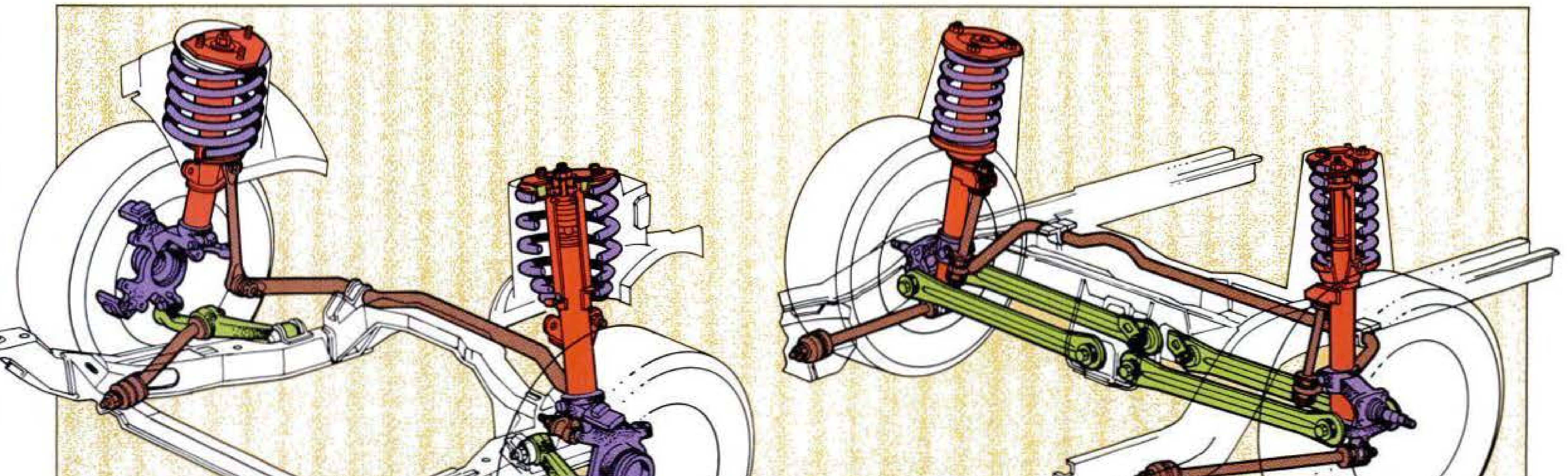

Taurus: the suspension story

Driving the new Taurus on city streets, my initial impression was that the chassis was heavy-handed. Later I began to appreciate its precise steering, stability, and controlled cornering.

"The key is the linearity of the suspension and steering," Clancy E. Scheffler, manager of large-car chassis and power trains at Ford, told me. Linearity allows the wheels to stay at constant angles to the road as they move up and down on the road surface.

The Taurus front suspension uses familiar MacPherson struts. Ford looked at other designs, says Scheffler, including the wishbone-style system used by Honda to lower the hood line of the new Accord. "But space for the transverse engine was at a premium," Scheffler said, "and we already had the height to accommodate the struts."

The front-strut geometry uses an unusually high caster angle of four degrees. (Caster is the measure of how steeply the steering axis of the front wheels is angled back.) "We were trying for a distinctive European feel," said Scheffler. "And the caster keeps the car tracking straight down the freeway." But because high caster angle means high steering effort, power steering is standard.

At the rear, Taurus uses parallel lower links and MacPherson struts. The system is more complex than the twisting beam axle used on many front-wheel-drive cars, but it allows the rear wheels to move independently for improved ride and handling.—***Dan McCosh***

PS ratings—test report in a nutshell

The ratings are based on test results and measurements. Results should be read with the understanding that they reflect tests only on our sample cars. An excellent rating is 5 points; very good, 4; good, 3; fair, 2; poor, 1; very poor, 0.

	Audi 5000S	Chevrolet Celebrity Eurosport	Dodge Lancer ES	Ford Taurus LX
Acceleration	5	5	5	5
Braking	2	3	3	2
Handling	5	5	5	5
Maneuverability	5	5	5	5
Quietness	2	2	3	3
Roominess	3	4	4	4
Vision	4	5	5	5
Entry/exit ease	5	3	2	3
EPA economy	3	3	4	4
Ride comfort*	4	3	3	4

*Authors' opinion

pens, the gases keep the pads from firmly contacting the discs, and stopping distances are longer than normal.

Our test car had a little over 1,000 miles on it. "You can have a car that has been driven and braked lightly and still have green linings," he said. "Also, the new non-asbestos brake linings take a little bit longer to wear in, though they will also last longer."

In the near future, PS will test a Sable station wagon, which uses the same front brakes as the Taurus. We will make certain that the brake pads are well broken-in, and will report what we find.

In day-to-day use the Taurus received only three minor complaints from our testers. The rear suspension rumbles like distant thunder, especially over rough surfaces. The cruise-control switches on the steering hub are impossible to see at night. And rain water drips onto the seats (and passengers) when the doors—cut high into the roof—are opened.

Overall, we were impressed with the way Taurus combines a European flair with traditional family-car virtues. One thing PS can't measure, however, is the car's long-term reliability. The engine, transmission, chassis, and body structure of Taurus are all new, and clean-sheet cars tend to have teething problems.

Best performer

If our car test had been a beauty contest, the Chevrolet Celebrity Eurosport wouldn't even have been a finalist. But its responsive engine, precise suspension, sticky tires, and powerful brakes helped make the boxy sedan the best performer in our group.

During our acceleration runs, the 2.8-liter V6 averaged 10.6 seconds from zero to 60 mph. Throttle response was rattlesnake quick, and the four-speed automatic transaxle shifted through the gears with quiet precision.

Handling was also quick and responsive, thanks to the stiff suspension and Goodyear Eagle GT tires that are part of the Eurosport package. Note, however, that the tires on our test car had about half their full tread

Continued

All the cars in our test group handled well, but the Celebrity Eurosport (top left) was the champ. Performance of the Audi 5000S (top right) appeared to be limited by the grip of its tires. The Dodge Lancer (above) earned high scores for handling and maneuverability, but it was the slowest in our test.

PS serviceability ratings

How easy is it to service these cars? To give you an approximation of how difficult it is for a typical person to perform various service operations, we examine each test vehicle. The numbers mean: 1, very difficult; 2, difficult; 3, average degree of difficulty; 4, easy; 5, very easy.

	Audi 5000S	Chevrolet Celebrity Eurosport	Dodge Lancer ES	Ford Taurus LX
CHECKING FLUIDS				
Battery	2	5	5	5
Master cylinder	5	5	3	5
Windshield washer	5	5	2	5
Engine oil	5	5	5	5
Coolant	5	5	5	5
CHECKING THE ENGINE				
Spark plugs	5	3	5	3
Distributor	5	5	5	5
Oil filter	3	3	5	3
Oil fill	5	4	5	5
REPLACING HOSES				
Upper radiator hose	5	5	5	5
Lower radiator hose	5	4	5	3
Heater hoses	4	4	5	4
CHANGING BULBS				
Headlights	5	3	3	5
Taillights	4	2	3	5
Front running lights	5	4	5	4
Front parking lights	5	4	5	3
Front directionals	5	4	5	3
Rear directionals	4	2	3	5
Rear running lights	4	5	3	5
CHECKING FUSES	4	3	5	5
CHANGING SPARE TIRE	5	3	3	4
CHANGING BELTS	3	3	3	5

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Don't let anybody kid you. There is no product that makes up for poor maintenance. RESTORE is not a "quick-fix" for mechanical problems such as leaks or bad valves. It is a technological innovation that fights the aging effects of friction and wear. With regular use it increases performance and prolongs engine life. RESTORE is for people who take care of their cars. Let RESTORE help you take care of your car.

If you have any questions or would like additional information, call our toll-free customer service line 1-800-222-2858. RESTORE. You'll feel the power or your money back.

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depth. When we received it, the Celebrity had 4,700 hard test miles on it, and the tires were well worn. Even on new tires, the Chevy probably would have been the handling champ. But the quick response provided by the short, stiff tread blocks of the worn Eagle GTs no doubt improved the numbers.

In the brake lane, the Chevy anchored an impressive 162-foot cold stop from 60 mph. With the brakes hot, stopping distance was almost identical (161 feet), and fade was minimal.

Performance has its price, and in the case of Celebrity the price is its three-box shape and dated interior. Outside, the car is simple and utilitarian. Inside, it looks more like a taxi cab than a European-style sports sedan. And the seat cushions are too flat to hold the driver in place, a serious drawback for a vehicle that generates such high cornering forces.

If the Celebrity was the hot rod of the group, we expected the Audi 5000S to reflect European sophistication. Indeed, the 5000S did have that elusive German feel. But our tests revealed the 5000S to be only an average performer.

The Audi's 2.2-liter five-cylinder engine was the smallest of the group, but it hauled the 5000S from zero to 60 mph in 11.8 seconds. And except for a little vibration at idle, the Audi engine was easily as refined as the larger Chevy and Ford V6s.

The stopping distances of our test car were only fair, but the brakes performed equally well cold and hot, and pedal pressure stayed low. The Audi was also the slowest through our handling and maneuverability tests, although it still earned an excellent rating in both tests.

The Audi interior looks Spartan compared with those of its domestic competitors. The controls are easy to use, the seats are supportive, and the driver can see the four analog gauges without peering around the rim of the steering wheel. The blue-and-gray striped upholstery of our test car

Continued

POPULAR SCIENCE TEST RESULTS

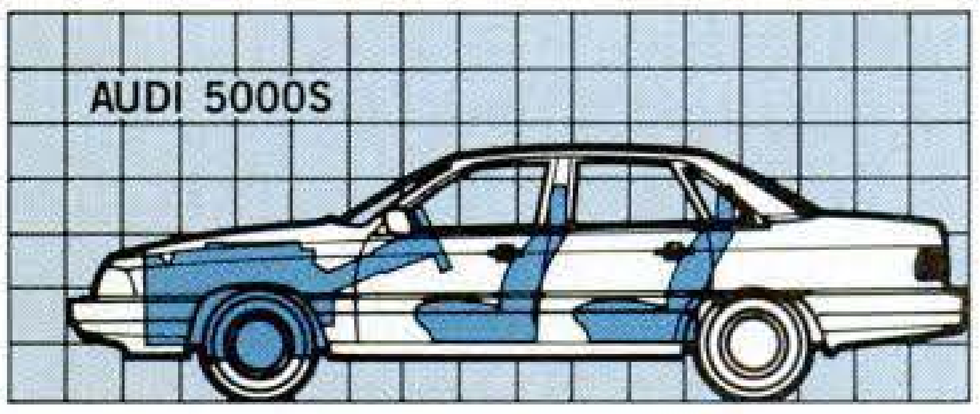
TEST RESULTS	Audi 5000S	Chevrolet Celebrity Eurosport	Dodge Lancer **ES**	**Ford Taurus LX**
Acceleration (sec.)				
0–30 mph	3.8	3.4	4.6	3.8
0–40 mph	5.7	5.2	7.0	5.7
0–50 mph	8.4	7.7	10.0	8.6
0–60 mph	11.8	10.6	14.13	11.8
Brake test (cool) 60–0 mph				
Stopping distance (ft.)	179	162	170	175
Pedal pressure (lbs.)	40	38	40	45
Brake test (hot) 60–0 mph				
Stopping distance (ft.)	181	161	167	180
Pedal pressure (lbs.)	35	25	34	105
Interior noise @ 60 mph (dBA)	68	67	65	66
Handling test (mph)	67.1	72.7	70.0	70.0
Maneuverability test (mph)	30.1	31.8	31.1	31.1
EPA FUEL MILEAGE **(mpg)**				
Highway	22	28	25	29
City	18	19	23	20

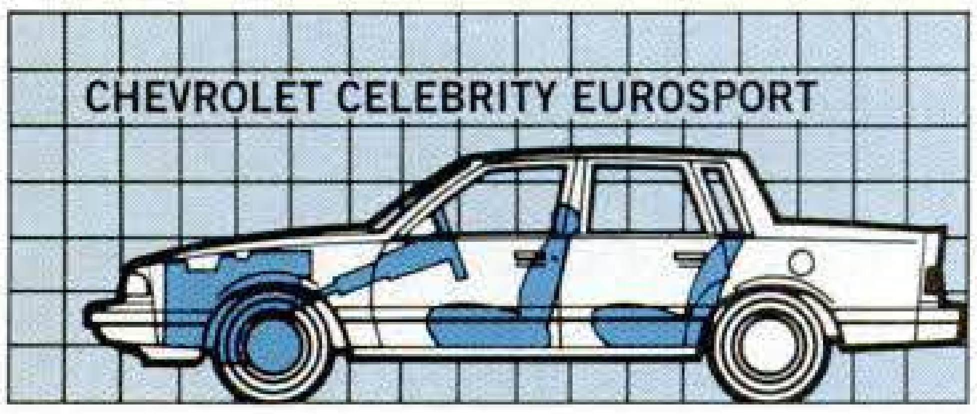
TEST CONDITIONS Ambient **temperature, 37° F; relative humidity, 60%;** barometric pressure, **29.8 in. Hg**

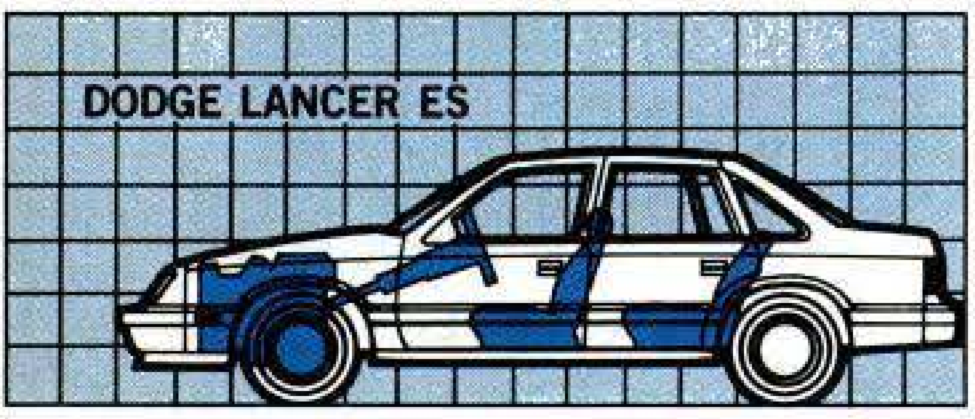
Dimensions and specs

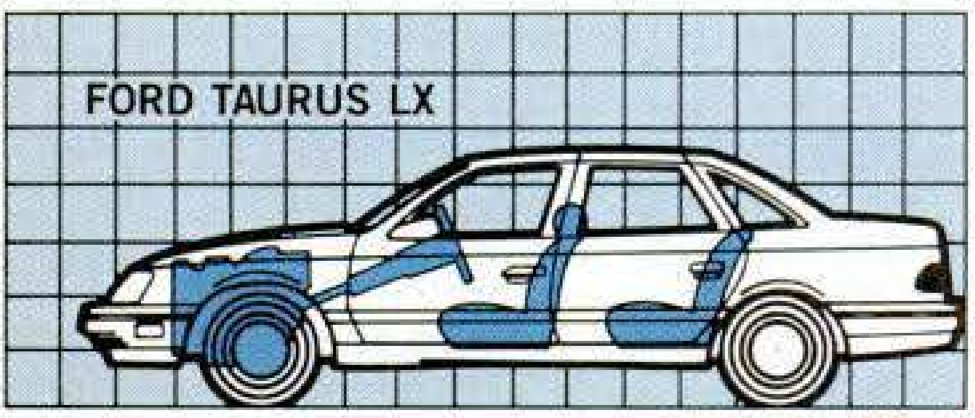
DIMENSIONS (inches)	Audi 5000S	Chevrolet Celebrity Eurosport	Dodge Lancer ES	Ford Taurus LX
Wheelbase	105.8	104.9	103.1	106.0
Overall length	192.7	188.3	180.4	188.4
Overall height	55.7	54.1	53.0	54.3
Overall width	71.4	69.3	68.3	70.6
Track, F/R	57.8/57.8	58.7/57.0	57.6/57.2	61.6/60.5
Ground clearance	5.2	5.7	4.8	5.1
Front head room	35.5	38.6	38.3	38.3
Front hip room	44.0	52.3	51.6	54.8
Front leg room	47.5	42.1	41.1	41.7
Rear head room	35.5	37.9	37.9	37.6
Rear hip room	53.5	53.6	51.9	54.8
Rear leg room (min.)	40.0	36.1	36.5	37.5
Rear knee room (min.)	2.0	1.3	1.7	3.0
Couple distance	32.5	31.9	32.1	33.2
SPECIFICATIONS				
Engine type	In-line 5	V6	In-line 4	V6
Displacement (cu. in./L)	136/2.2	173/2.8	153/2.5	182/3.0
Compression ratio	8.5:1	8.5:1	9.0:1	9.3:1
Carburetion	E.F.I.	E.F.I.	E.F.I.	E.F.I.
Net hp @ rpm	110 @ 5,500	125 @ 4,800	100 @ 4,800	140 @ 4,800
Net torque (ft.-lbs.) @ rpm	122 @ 2,500	160 @ 3,600	136 @ 2,800	160 @ 3,000
Transmission	3-speed automatic	4-speed automatic	3-speed automatic	4-speed automatic
Axle ratio	3.46:1	3.06:1	3.02:1	3.37:1
Tire make	Continental	Goodyear	Goodyear	Firestone
Tire type	Contact radial	Eagle GT radial	Eagle GT radial	Supreme radial
Tire size	185/70SR14	P195/70R14	P205/60HR15	P205/65R15
Steering	Power, rack and pinion	Power, rack and pinion	Power, rack and pinion	Power, rack and pinion
Overall steering ratio	18.7:1	15.7:1	14.2:1	15.25:1
Turns, lock to lock	3.50	3.05	2.05	2.52
Turn diameter (ft.)	34.2	37.0	42.9	38.7
Front suspension	Independent, MacPherson struts, coil springs	Independent, MacPherson struts, coil springs	Independent, Iso-struts, coil springs	Independent, MacPherson struts, coil springs
Rear suspension	Torsion crank axle, trailing arms, coil springs	Trailing arm, open-section transverse beam, coil springs	Trailing flex arm, track bar, coil springs	Independent, MacPherson strut, coil springs
Front stabilizer-bar diameter (in.)	—	1.10	1.06	0.80
Rear stabilizer-bar diameter (in.)	—	0.79	1.13	0.79
Brakes	Disc-drum	Disc-drum	Disc-drum	Disc-drum
Brake swept area (sq. in.)	—	277.0	253.1	280.2
Fuel tank (gal.)	21.1	15.7	14.0	16.0
Trunk space (cu. ft.)	16.7	16.2	18.3	17.0
Liftover height (in.)	—	31.9	26.1	30.0
Curb weight (lbs.)	2,844	2,719	2,716	3,109
F/R weight distribution (%)	—	62/38	61/39	65/35
Base price	$18,065	$9,345	$10,250	$13,351
Price as tested	$20,820[1]	$12,768[2]	$14,424[3]	$15,223[4]

Major options (over $100) [1]trip computer $210, clear-coat metallic paint $370, electronically tuned radio $390, automatic transmission $475, electric sun roof $975; [2]tilt wheel $115, rear defogger $145, cruise control $175, power seats $225, aluminum wheels $306, electronically tuned radio $504, 2.8-liter V6 $560, automatic overdrive transmission $665, air conditioning $750; [3]lift-gate wiper-washer $129, cold-weather package $197, 2.5-liter engine $279, automatic transmission $478, wheel and tire package $504, electronically tuned radio $509, air conditioning $780, luxury-equipment discount package $872; [4]styled wheels $113, electronically tuned radio $127, rear defogger $145, premium sound $168, cruise control $176, electronic climate control $183, six-way seat $237, electronic instruments $305









GRID BLOCK = 1 SQ. FT.

DRAWINGS BY RUSSEL VON SAUERS

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Factor in a base model priced $609* less than Ford's, and it's no miracle more people bought Chevys this past year† than any other truck. And that's the gospel truth.

*Based on 1986 Manufacturers' Suggested Retail Prices for full-size pickups. Equipment levels may vary. †Based on Manufacturers' Reported Retail Deliveries for 1985 model year.

NOTHING WORKS LIKE A

CHEVY TRUCK

looked and felt as good as a $500 suit.

The fourth car in our group, the Dodge Lancer ES, was far slower than the others. For 1986, Chrysler offers a 2.5-liter four-cylinder equipped with single-point fuel injection and twin balance shafts. But with its modest 100 horsepower, our test car simply couldn't stay with the pack. During hard acceleration, the engine sounded strained, and the shifting of the three-speed automatic transmission was harsh and noisy. Once at cruising speed, however, everything settled down, and at 60 mph the Lancer was the quietest car in our group (65 dBA).

Like the Celebrity, the Lancer was fitted with Eagle GTs, and it waltzed through our handling and maneuverability tests with excellent scores. Cold and hot braking were about average.

The interior of the Lancer seems dated, though not as much as that of the Celebrity. The instruments and controls are well placed, but, as in the Chevy, there is an impression of cheapness. The carpeting in the Lancer looks thin, the door panels flex when the power windows operate, and the shift lever clunks in its gate.

In our group, the Celebrity emerged as the performance champ. But we can assure all those curious onlookers that the Taurus provides a satisfying mix of European and American virtues at a competitive price.

Testers' choices

Each of the cars in our group had its own personality. Of the four, I found the Lancer the least appealing. The car needs a V6. The 2.5 is just not powerful enough, and the noise and vibration make the optional 2.2 turbo too crude for comparison with the two V6s and the Audi five.

As for the Audi, its price tag is its greatest liability. With a non-turbo engine, automatic transmission, and all-season tires, it is only an average performer. Yes, it does have that wonderful European feel. But $5,000 worth?

The Celebrity reminded me a bit of a police car—lots of power, stiff suspension, and plain-Jane trimmings. But if you want performance at a modest price, Celebrity is the choice.

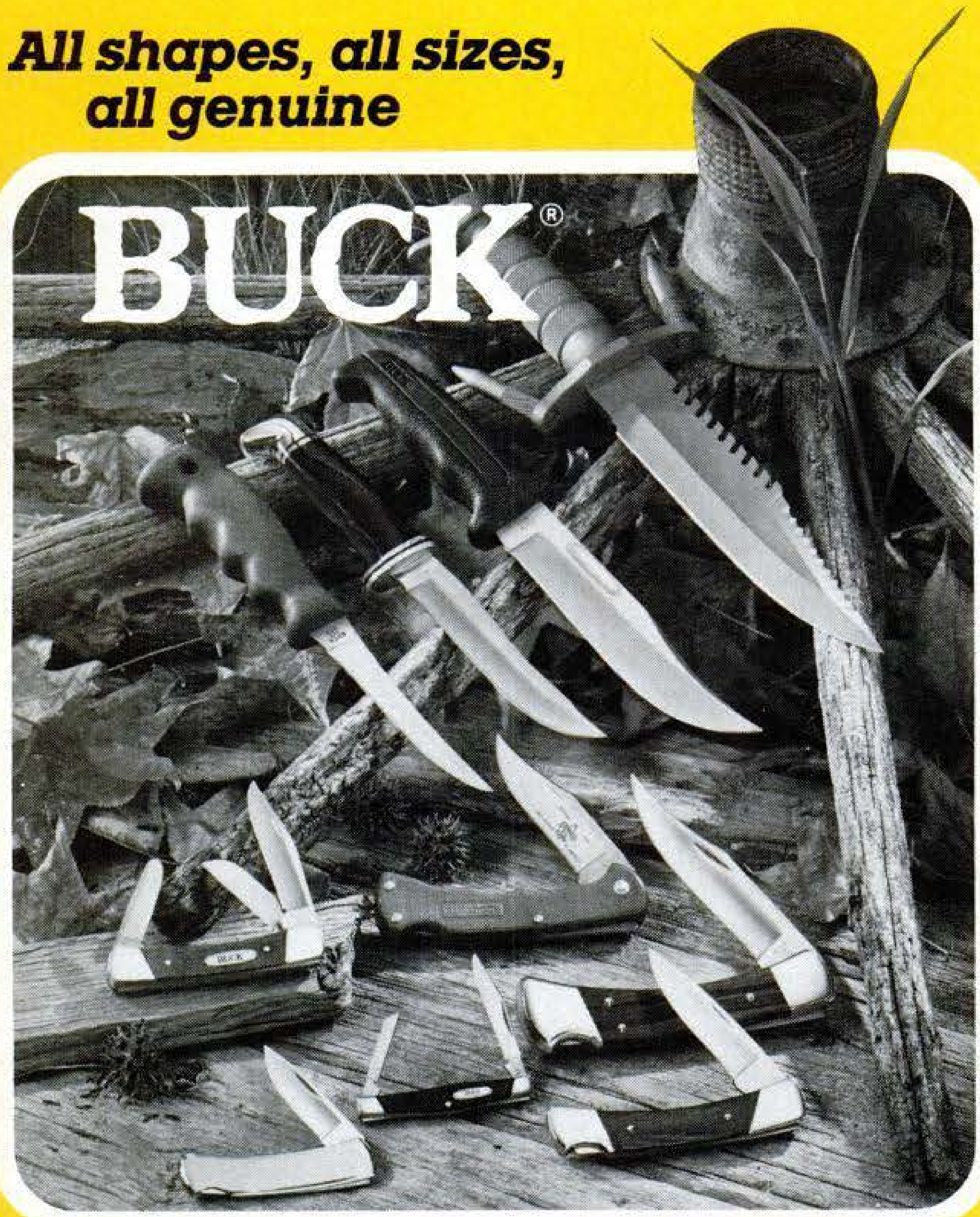
Ford has raised the standard for four-door sedans with Taurus. It's attractive, reasonably fast, handles well, and is comfortable. The possibility of first-year teething problems gives me pause, and I wish the brakes had shown a bit more bite. But for day-to-day driving, I'll take Taurus.—T. W.

The automotive equivalent of Clark Kent's glasses and street clothes, this Chevy's three-box shape and harvest gold paint hide a terrific performer. Celebrity was best in acceleration, braking, and handling. But perhaps more important, there is a well-seasoned quality to this vehicle.

Ford Taurus lacks the refinement that only time will bring. It is, however, an incredible achievement for Ford in styling, design, and engineering.

It appears that Audi has some respectable competition from the American marketplace. The Audi cabin remains a standard of considerate ergonomics and tasteful, purposeful interiors. My prescription for 5000S owners who want better braking and handling is a wider, stickier tire.

Nobody wanted to drive the Dodge Lancer home from the test site. I'm not sure why. Was it the lack of power, the cheapness of the interior materials, or the mechanical noises from the drive train? The objective numbers Lancer provided in our tests were respectable, but I don't remember other Lancers I have driven being this rough-edged. Our test car didn't seem representative of the Chrysler H-body family, or of the 2.5-liter four.—J. J. K.



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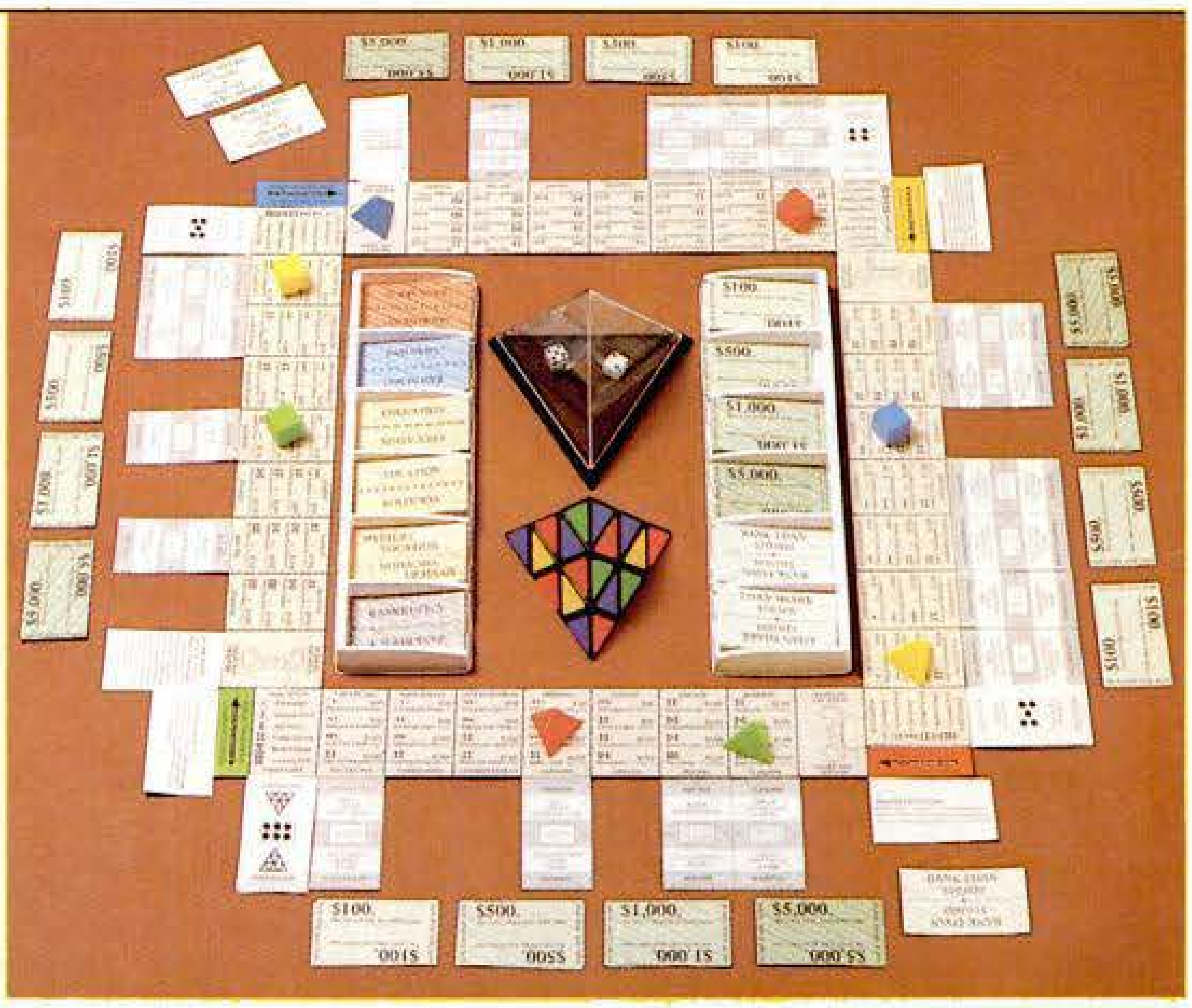
The GOOD NEWS! BAD NEWS! Game

This game is logically simple to play since the playing track is very clearly marked and the various cards have step-by-step instructions.

It is fun to "Bad News!" your opponents

When an opponent lands upon one of your vacant cardless spaces, you have the option of taking a **"Good News Card"** for yourself or you can force him/her to take a **"Bad News Card"**. Since many of **the cards are humorous, it is fun to "Bad News!" your opponents.**

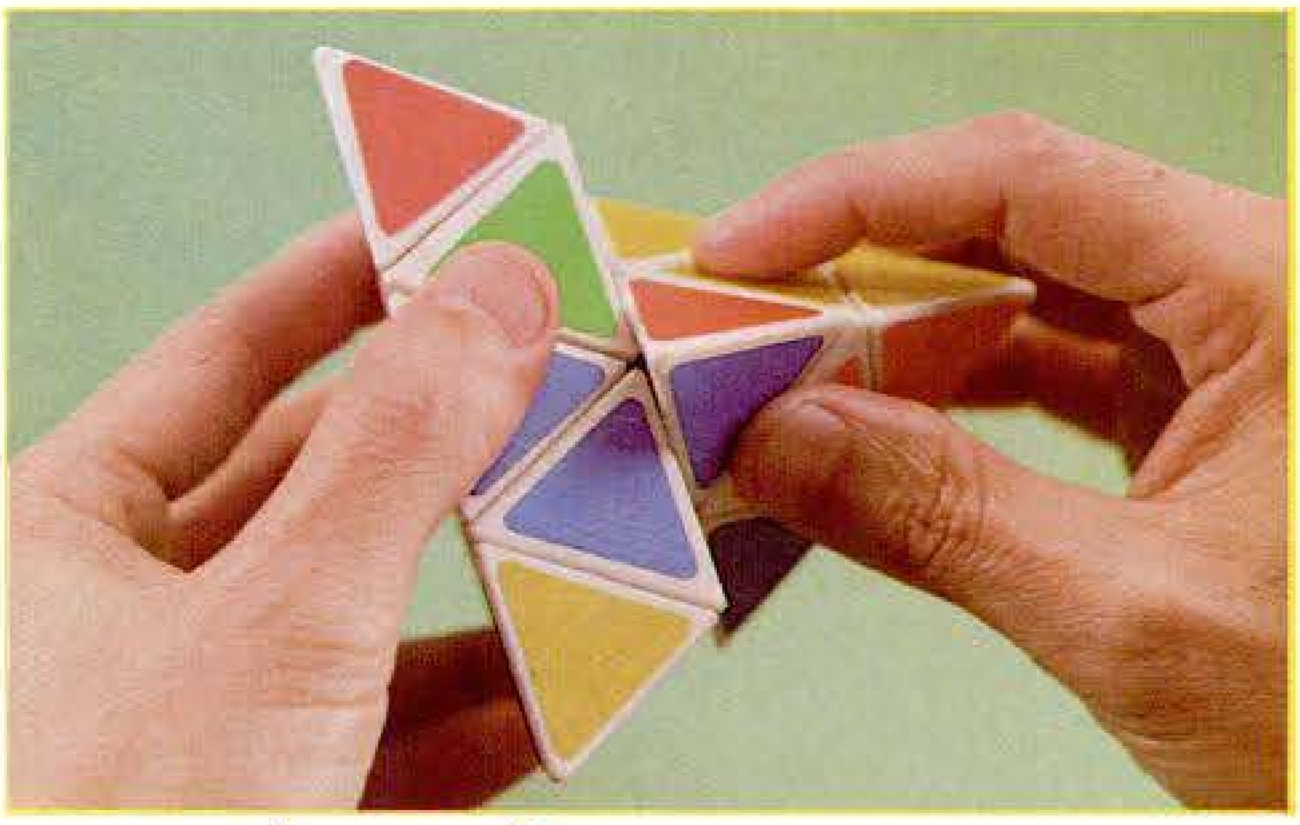
You acquire **"Educational Qualifications"** which enable you to obtain various **"Vocations"** so as to charge **"Fees"**. When short of money, borrow from **"The Bank"** or from avaricious **"Loan Shark"**. If hopelessly in debt, declare **"Bankruptcy"**; you'll still have a chance to win the game. The object is to devastate other players and be the richest! Or, at least, the least poor! ***"Inferiorate"* your opponents!**



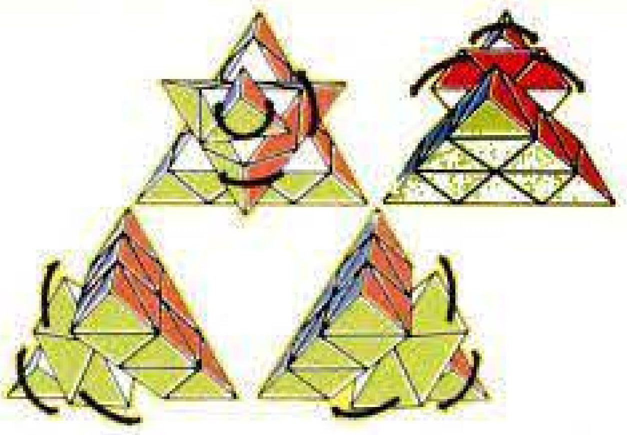
This Game Is Fun To Play!

There's fun and action on almost every move and, more importantly, **there is strategy involved in this game which can offset most bad luck,** therefore an intelligent player, who has mastered it, will invariably win.

The spaces you move on your turn can be influenced by opting to use the **"Pyraminx" (minimal skill)** instead of shaking the **Dice (luck).** Avoiding low paying vocation spaces, for which you qualify initially, maximizes your chance to later get more than your fair share of the lucrative positions after attaining higher educational qualifications. Of course, even an expert can not expect to get all of the best jobs, but what he/she can do is to leave some low paying ones vacant and **"Bad News!" all opponents into financial oblivion! It's a lot of fun!** All of this will make sense after you've read the enclosed instructions.



The designated **Adult Cards can be excluded** if children are playing, or adults sensitive to certain subjects joked about on Bad News Cards. No cards are really X-Rated, but some Adult Cards quote embarrassing subjects covered by Newspapers & TV which must pertain to someone! Use discretion and delete cards which could be found objectionable. **Or just go ahead and offend your friends! This Game Is Fun To Play!**



PYRAMINX™

As a puzzle, you attempt to twist so each side becomes a solid colour. In this game, you use minimal skill to get the desired number of your colour triangles on side with most which determines spaces you move.

* The "$9" is for processing your initial order including press releases to solicit publicity in your local newspapers. Subsequent orders will be sent freight pre-paid in the shipping cartons containing ten games for $50 meaning your delivered-to-door cost will be truely $5 per game. *"The GOOD NEWS, BAD NEWS Game"* is predicted to become a best seller since it is so much fun to play and successful sales will aid in launching a *TV Game Show* using the name which, in turn, will generate more sales.

FAILURE? In case you should fail to sell a single game (either to acquaintances or thru shops) you'll be out the time you spent with an expenditure of $59 in cash which is a small disbursement considering the potential gain, and **satisfaction is guaranteed or money back**: $5 refund for unopened games returned to Quadra-Scan within 30-days.

SUCCESS? If you are successful in "moving" the games, there will be other Games & Toys for you to distribute. This is not intended to be a one shot deal. The intention is to establish a high volume Games & Toys distribution network of individuals like you selling thru small stores enabling lower prices than the giant chain stores can offer.

GET RICH QUICK? No! Distributing Toys & Games will not achieve that if it is your goal. It will, however, provide good income and personally save money on gifts! It is intended to have other Games & Toys in time for the 1986 Christmas Season. As an Authorized Distributor, you'll be able to handle all A-O-A/Quadra-Scan products.

DISTRIBUTION/MARKETING is the key to success in the Games & Toys business. "Big name" manufacturers and distributors have their men on the road canvassing all the big stores where their products are stacked with all the competition, hoping that their vast expenditures on advertising will make their products stand out among the competition. We are adopting a new approach. We want to line up a large number of part-time distributors who will place our games and toys in small "Mom & Pop" stores which have a small selection of games and toys or even no other toys or games! You personally patronize small stores in your locality whose operators would no doubt be willing to display "your" game to help you as well as see if they can make some extra profit. If they do sell a reasonable volume, they will be interested in additional toys and games which you will also handle.

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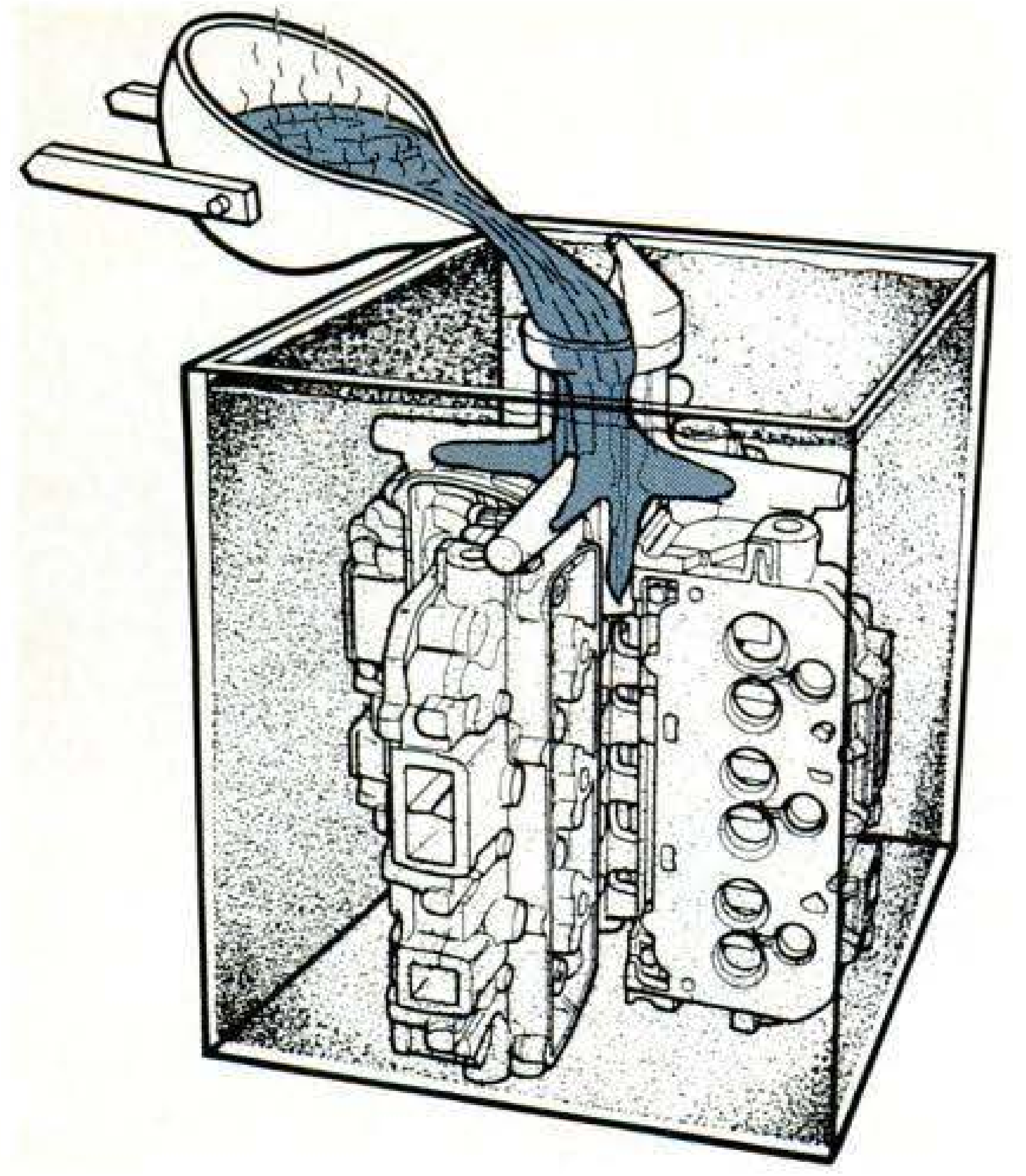

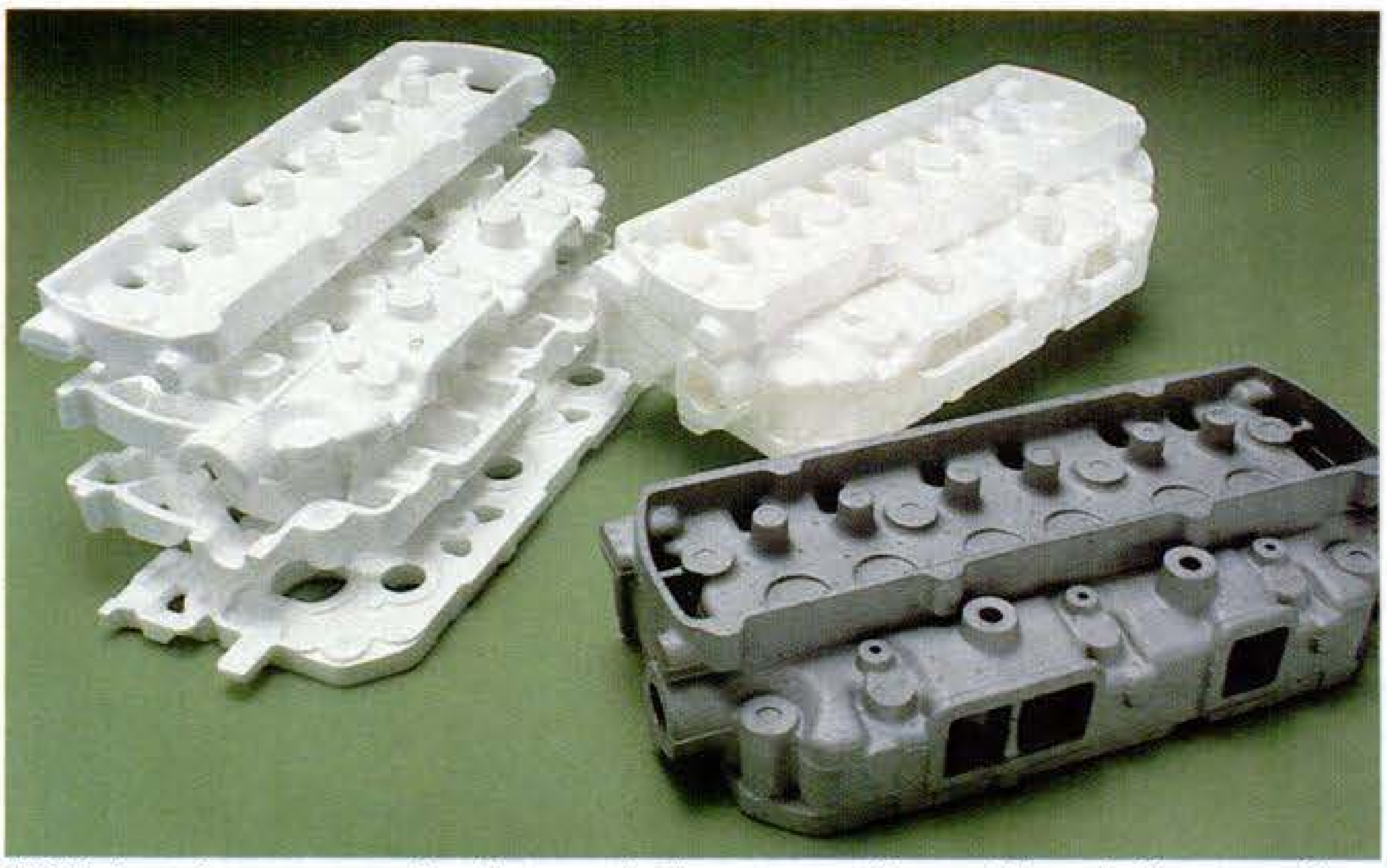

With lost foam, complex internal shapes are formed by gluing together molded plastic cross sections (above). Left: Four cylinder heads are cast at once in a sand-filled pouring box. The molten metal replaces the polystyrene pattern, leaving an exact replica of the mold's shape.

Lost foam—a new way to cast car parts

Lost-foam casting uses polystyrene beads—the kind coffee cups are made from—to form exact-dimension molds. Its first production use will be casting cylinder heads for General Motors cars.

By RICHARD LAYNE

"With this process you can cast almost any shape you want," said Jack Tedrow, production manager at General Motors Corp.'s central foundry in Messina, N.Y. His voice somehow cut through the plant's din as he showed me an intricately shaped plastic pattern. That pattern, which reminded me of a flip-top egg carton, is the key component in GM's lost-foam production line.

In conventional auto-part foundries, workers pack sand mixed with bonding agents over metal patterns and bake the sand to form hardened upper and lower molds. With these mold sections clamped together, molten metal for parts flows into empty cavities. But at GM's Messina plant, sand encases plastic patterns that vaporize—are lost—as hot metal strikes them.

Tedrow was suddenly interrupted. "You didn't scratch it, did you?" asked a worker hurrying over, nodding at the featherweight plastic pattern—a replica of a cylinder head—cradled in Tedrow's hands. "No, I didn't even let my fingernails nick it," Tedrow replied. He must have noticed my raised eyebrows: Nobody is dainty amid the heavy machinery of a casting plant. "You can run your fingernail along the pattern, and that tiny indent will show up on the casting," Tedrow explained. "That's how well lost foam duplicates the pattern's shape."

That capability is the biggest asset of lost foam, which could become the best way to cast increasingly complex car parts. Vehicle manufacturers, including Ford Motor Co. and John Deere & Co., have been trying for years to tame the process, in which polystyrene beads form an exact-size pattern that's dissolved during casting. So far, lost foam has only been used successfully for one-of-a-kind oddities and some marine hardware.

Now GM engineers say they're ready to go on-line with the process. The guinea pig: an aluminum cylinder head with a complex port and cavity design—an ideal tryout for lost foam's precision. The head will fit a two-liter engine slated for some 1987 models, including Chevrolet's new Beretta.

To obtain soft plastic that can be stamped into a lost-foam mold pattern, you start with hard beads of polystyrene. Steam is blasted into desk-size drums filled with beads, expanding the raw plastic bits—much like making popcorn. Now twice their original sugar-crystal size, the beads flow into an overhead pneumatic tube in a snowstorm-like swirl, then into an injection-molding machine the size of a freight elevator. There, mating steel plates stamp out mold sections, which are later glued together to make a pattern. When the steel plates separate, plastic mold forms drop through the floor and float away in a water tray.

I watched one ultra-light section—it weighed about an ounce—rocking gently on the shallow water. Why, I asked, does GM stamp out separate sections?

"That way we create a cylinder head's complicated ports and cavities just by gluing together patterned sections," Richard Jacques, senior manufacturing engineer told me. "We can create any shape just by adjusting the pattern." Conventional casting forms ports and cavities by pushing specially shaped sand wedges, called plugs, into the mold. After casting, workers pull out the sometimes fragile, often unreliable plugs.

On the lost-foam production line, which occupies more than a football-field of space in the immense foundry, workers assemble the plastic sections first into exact-size patterns, or replicas, of cylinder heads, then into easy-to-handle clusters. Thirty feet away, other workers dunk these clusters into a vat, coating them with a water-based ceramic. This step is crucial to lost foam—and was a major stumbling block in the past. Until recently, say GM engineers, the proprietary coating wasn't refined enough to be effective.

Tedrow showed me the importance of the coating as we completed the factory tour: Under dim factory lights, the racks of white-plastic patterns glare through this flesh-colored ceramic skin, only $^{3}/_{1,000}$ inch thick. An overhead arm snatches up a cluster, carries it high above the factory floor, and suspends it in a pouring box. In seconds, about five cubic feet of sand fills the container. Hoisted onto an adjacent shaking table, the box vibrates vigorously, forcing sand into each pattern's recesses and ports.

Molten metal

Next, the pouring box moves before a furnace of molten aluminum. A ladle on the furnace's pouring arm scoops up 120 pounds of the 1,400-degree-F metal. As the arm swings over the cluster and dumps the molten metal, the coating becomes critical.

"The coating is a transfer mechanism to get the polystyrene gas, created by the molten metal, out of the cavity," said Jacques. "When you add the hot metal, the plastic pattern turns soft [before vaporizing]. The coating also maintains the pattern's original shape and keeps the sand from pouring into the cavity." Twenty-five minutes later, the metal has set in the shape of the pattern it's replaced.

Is a lost-foam cylinder head superior to a conventionally cast model? It's reportedly lighter—23 pounds versus 25 pounds. But Tedrow believes that lost foam offers other pluses. "We can let a product engineer capitalize on the most efficient design," he said. "As port design in cylinder heads becomes more complex, a lost-foam head will be better."

Lost foam's future seems promising. GM engineers believe the process will be used for selected auto parts, perhaps even complex combustion chambers. And GM may also use lost foam to increase its share of another multibillion-dollar market—casting appliance parts. PS

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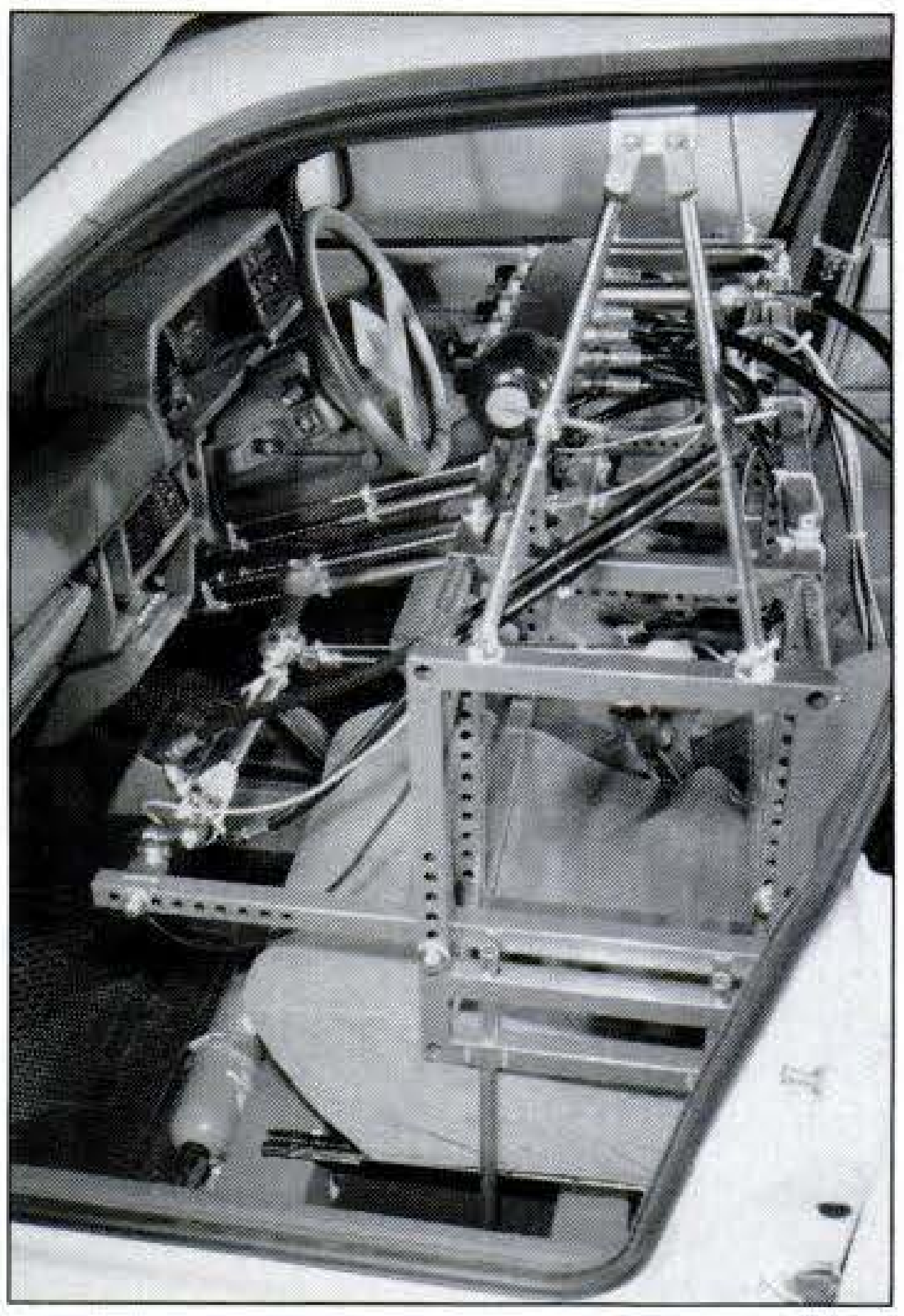
Robot driver racks up the miles for lab tests



It never falls asleep at the wheel, doesn't require rest stops, and never demands overtime pay. Instead, this electrohydraulic driver follows any driving cycle programmed into its computer, allowing accurate, repeatable tests for exhaust emissions, fuel economy, and vehicle durability.

The machine can't see, so the vehicle being tested drives on a rolling-road dynamometer. The boxlike robot fits over the front seat, where it is supported by metal legs and clamped to the door frames. It has individual hydraulic cylinders for accelerator, brake, and clutch pedals. Two more cylinders are paired to work the gear selector, and can be programmed to follow any shift gate.

During stick shifts, a feedback signal monitors engine speed, and the accelerator and clutch are coordinated for smooth engagement. The robot can handle up to six forward speeds, and gear-change times are variable from one to five seconds. The machine can also operate the lever for an automatic transmission.

Built by Britain's Motor Industry Research Assn. (Watling St., Nuneaton, Warwickshire CV10 0TU), the robot can perform driving sequences for specific lab tests, or it can follow a computer program recorded while driving on an actual road or track. Best of all, it is immune to the fatigue and errors that often plague human drivers during lengthy, boring mileage-accumulation tests.—*David Scott*

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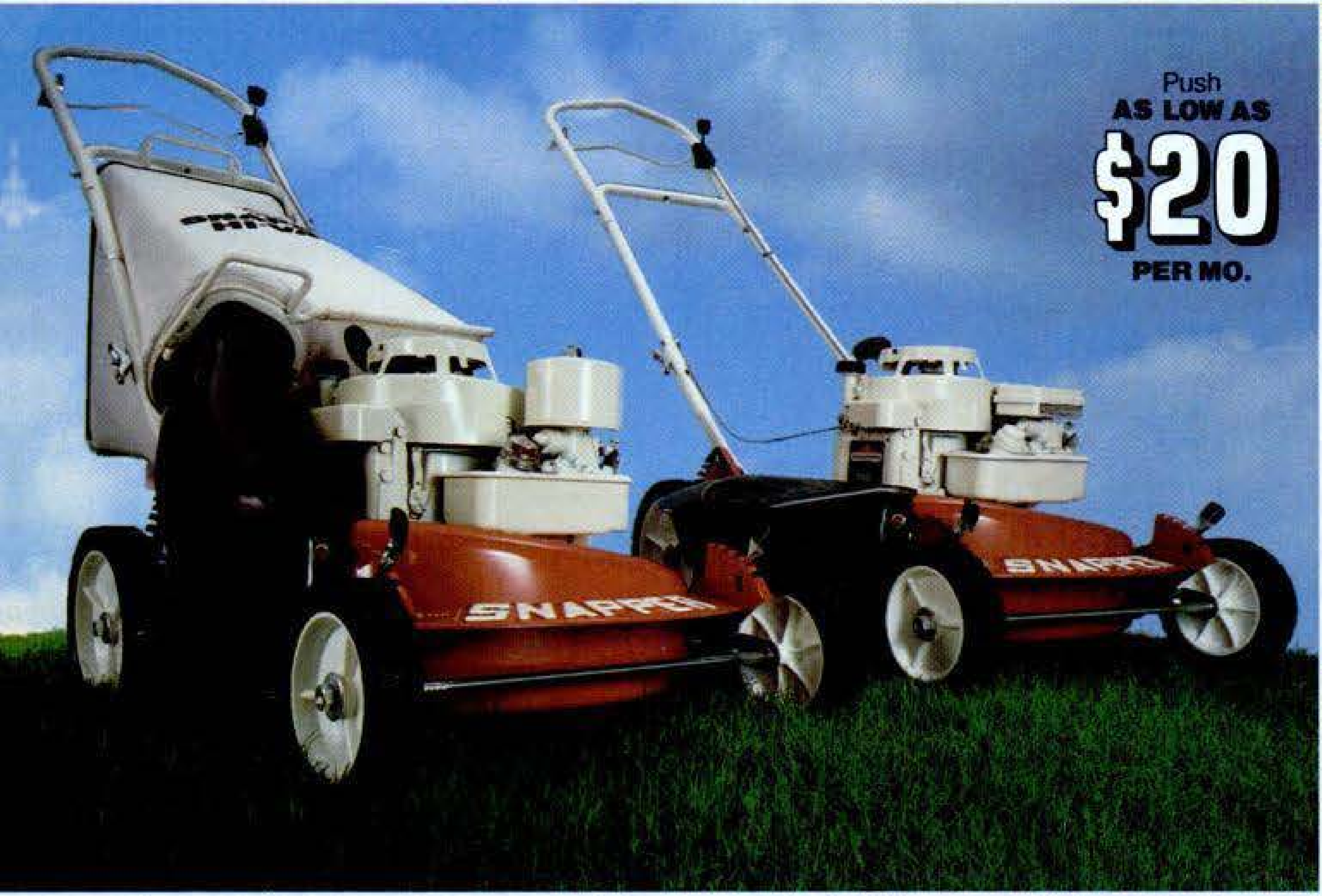

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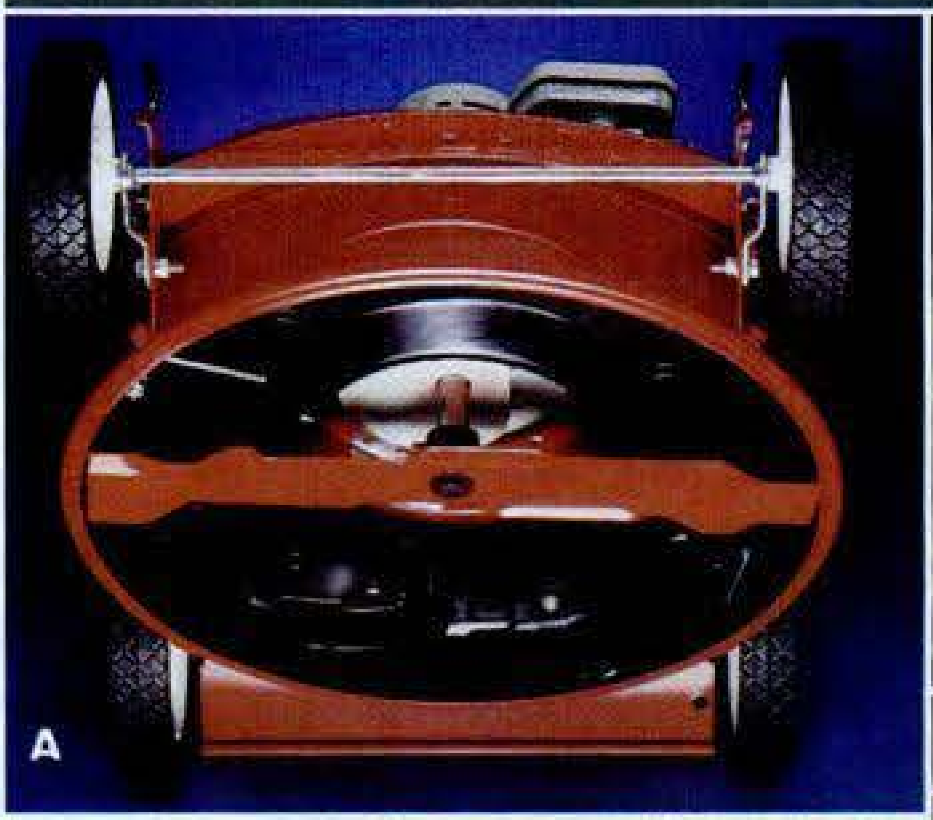
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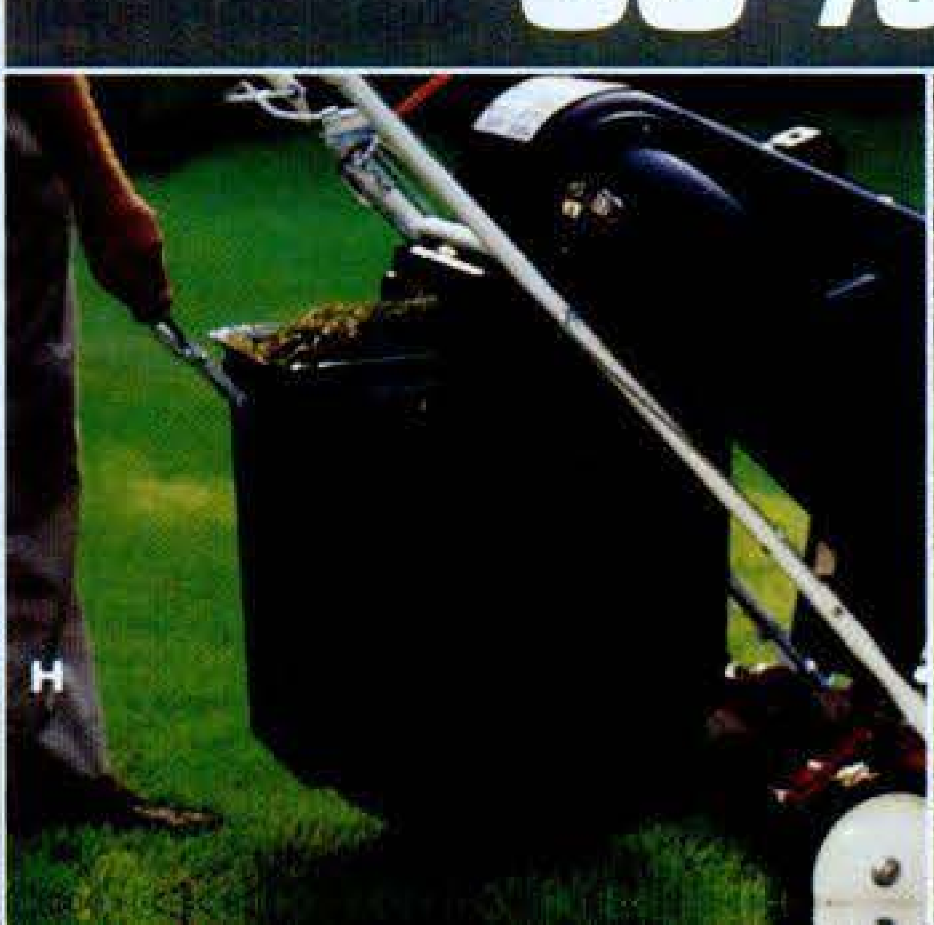
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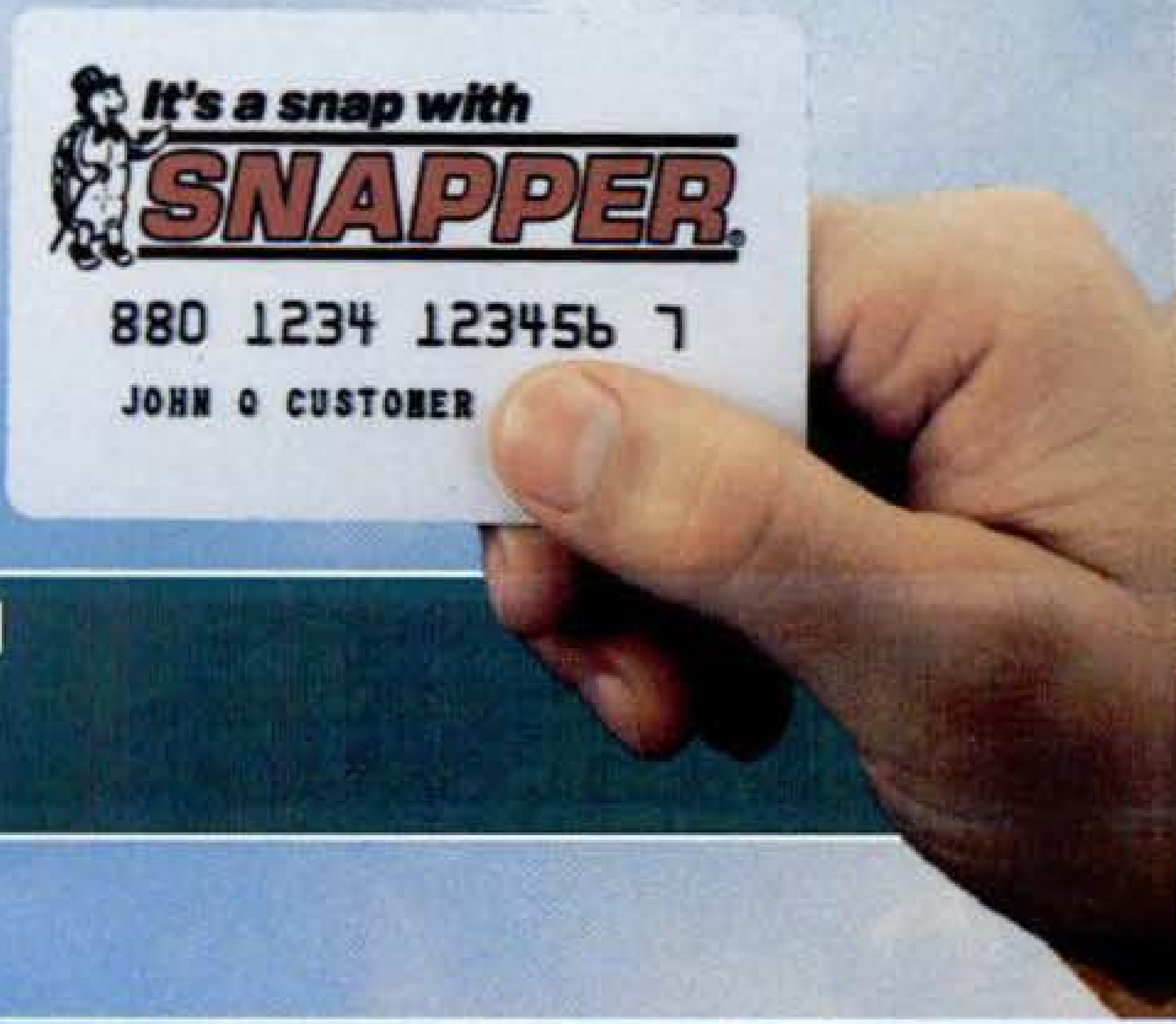
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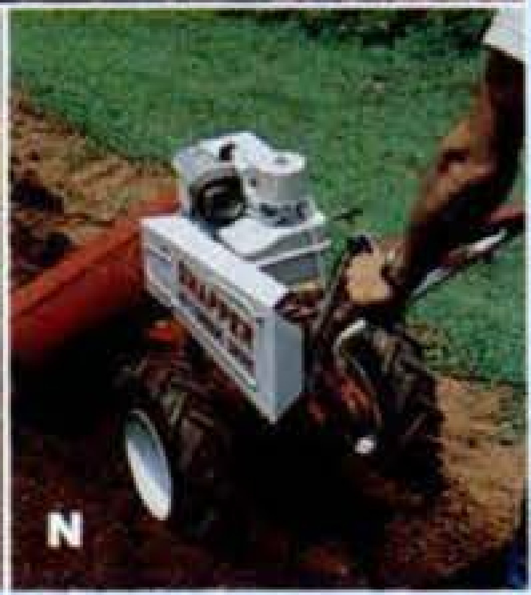
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New probes of the
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Last year, near a windswept icecap in Greenland, two multistage rockets streaked skyward almost simultaneously. The launchings were synchronized with the Hi Lat satellite that arced over the Northern Hemisphere at the same moment. Both obsolete military rockets moved eastward, reaching altitudes of 400 and 1,000 miles and penetrating the regions where the aurora borealis (northern lights) occur. Instruments aboard the rockets beamed data to members of the scientific team below.

Data gleaned from a series of rocket probes should help researchers understand the electric and magnetic properties of plasmas—turbulent beams of charged particles that create the aurora. Mysterious blobs—2,000-degree-F concentrations of plasma—that race at two miles a second across the polar regions are also being investigated.

The experiments should aid understanding of radio transmissions and the weather. Results may also hasten the development of fusion reactors—superhot plasmas contained in magnetic fields that promise an inexhaustible source of energy [PS, May '82].

Why brave sub-zero temperatures and 100-mph winds at Sondre Stromfjord on Greenland's west coast? The scientists picked the time and location because the tilt of Earth's axis away from the sun allows an extraordinarily turbulent interaction between solar-wind particles and the magnetic field in the region. Also, explained Michael Kelley, the Cornell University plasma physicist who coordinated the international research program, to someone in Greenland the northern lights are actually southern lights. "This gives us a new perspective and allows us to launch rockets north of the aurora down into southern regions," he said.

The first two of nine scheduled launchings required unusual coordination. To determine when ionospheric conditions were right, researchers monitored data from the Hi Lat (High Latitude) spacecraft. Radar beamed into the heavens also provided clues. The scientists could also view the aurora for long periods because darkness prevailed even near noon.

"It was one of the first times researchers put together all these types of measurements into the same event," said Kelley, an engineering professor who began this type of research in 1966 as a graduate student. Preliminary results indicate the satellite-rocket-radar approach—vertical soundings coupled with horizontal ones—offers valuable three-dimensional information. "The data sets really merge together quite nicely," Kelley told me.

Cornell researchers concentrated on measuring electric fields in space. Scientists from the University of California at San Diego and Berkeley fitted their rocket probe with instruments to measure the flow of electrons. For the electric-field measurements, sensors are mounted on long booms that extend from the rocket above the atmosphere. "These make contact with the medium—in effect they become a voltmeter," said Kelley.

"The UC people built a 'smart' instrument that detected when events occurred, stored the data on board in a memory bank, then spat it back out at their leisure between events," Kelley said. "That's never been done in space before." To count electrons in space, particles entering an instrument aperture travel along a curved path with a voltage across it. "By sweeping that voltage, the number of particles that get through tells you the number of particles in space of a certain energy," he explained. Before an electron is counted electronically, it enters a multiplier that avalanches a single electron into a billion.

Other researchers among the 25 scientists were from Denmark, Norway, and Peru. The Danish Meteorological Institute joined Cornell in launching rockets to plot the velocity of both the electrically neutral atmosphere and charged plasmas. The rockets begin a chemical reaction using thermite that is hot enough to vaporize barium. Ions that result, visible from ground stations, move with the plasma. "We were quite excited to see how the ionosphere plasma actually puts the neutral atmosphere in motion," Kelley said. Scientists plan to return to Greenland for more rocket experiments in 1987.—*John Free*

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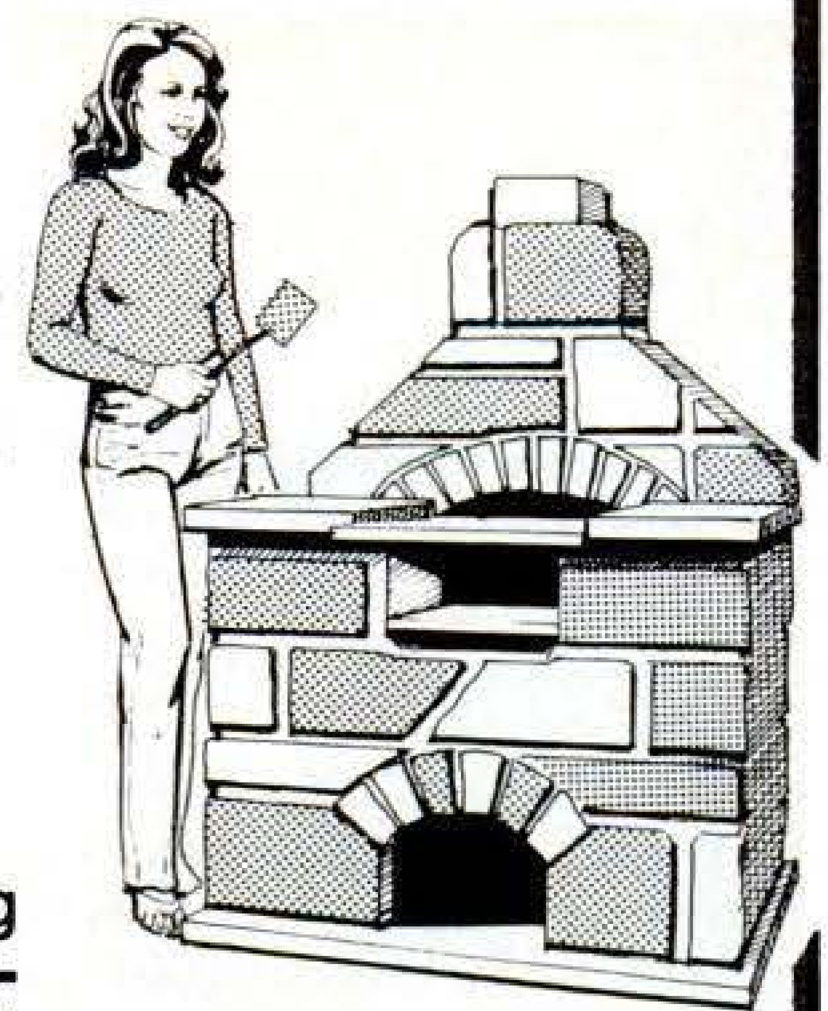

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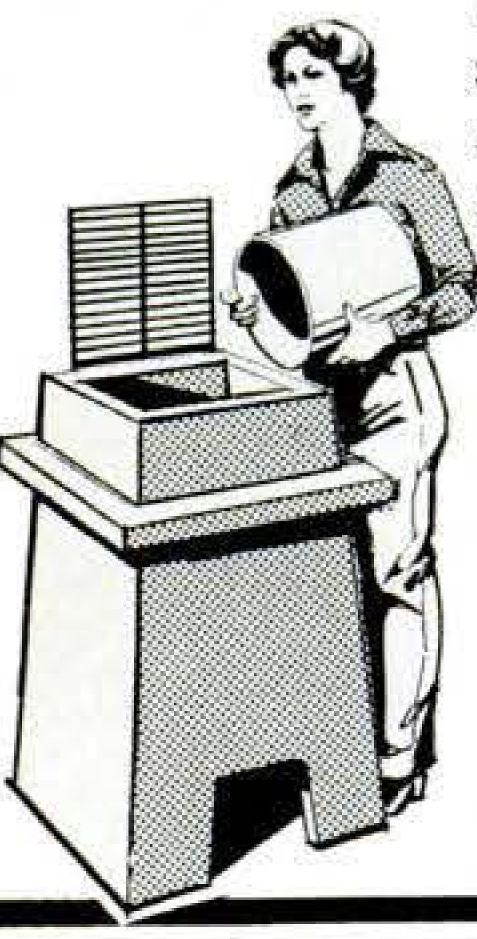

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Facts for free: no-charge data bases

I enter "movies" into my computer and receive the schedules for Boston's Sack Cinema. Keying in another code yields information on Boston-area hotels. A third summons information on Avis rental-car services, including addresses of all Boston locations. In less than 10 minutes, for the cost of a single long-distance call, my computer has rounded up all the information I need to arrange my trip to Boston.

I am using CitiNet, one of a new breed of home data-base services. Home data bases are not new; CompuServe and The Source are nearly a decade old. But these new services differ from other systems in one important aspect: They're free. All you have to do to use either CitiNet (Boston) or The Shuttle Express (Seattle) is call them up. Totally advertiser-supported, they are gambling that they can generate enough new business to make themselves worthwhile to major ad buyers.

The new data bases seem to have made a good start, particularly in the area of services. Both systems provide information on special events at local museums, galleries, and other public facilities. The Shuttle Express provides weather reports for the Seattle area, and is even considering an on-line grocery-ordering service in conjunction with a company that will deliver food to your door. CitiNet rents electronic mailboxes and sells classified ads.

Both have won the support of local computer buffs with such services as computer club meeting schedules and listings of used computer equipment for sale. The prestigious Boston Computer Society also runs a large public listing on CitiNet.

So far, free data-base services are available only in Seattle and Boston, although another system called Video-Billboard (Box 164, Ryder Station, Brooklyn, N.Y. 11234) offers similar information on the New York City area for $50 annually.

But stay tuned. Both CitiNet and The Shuttle Express hope to expand to other cities. According to the two companies, cities across the U.S. and Canada will have free, city-wide data services within two years. Meanwhile, the next time you want to find out what's going on in Boston or Seattle, use your computer. CitiNet's number is (617) 489-4930. The Shuttle Express can be called at (206) 885-4636.—*G. Berton Latamore*

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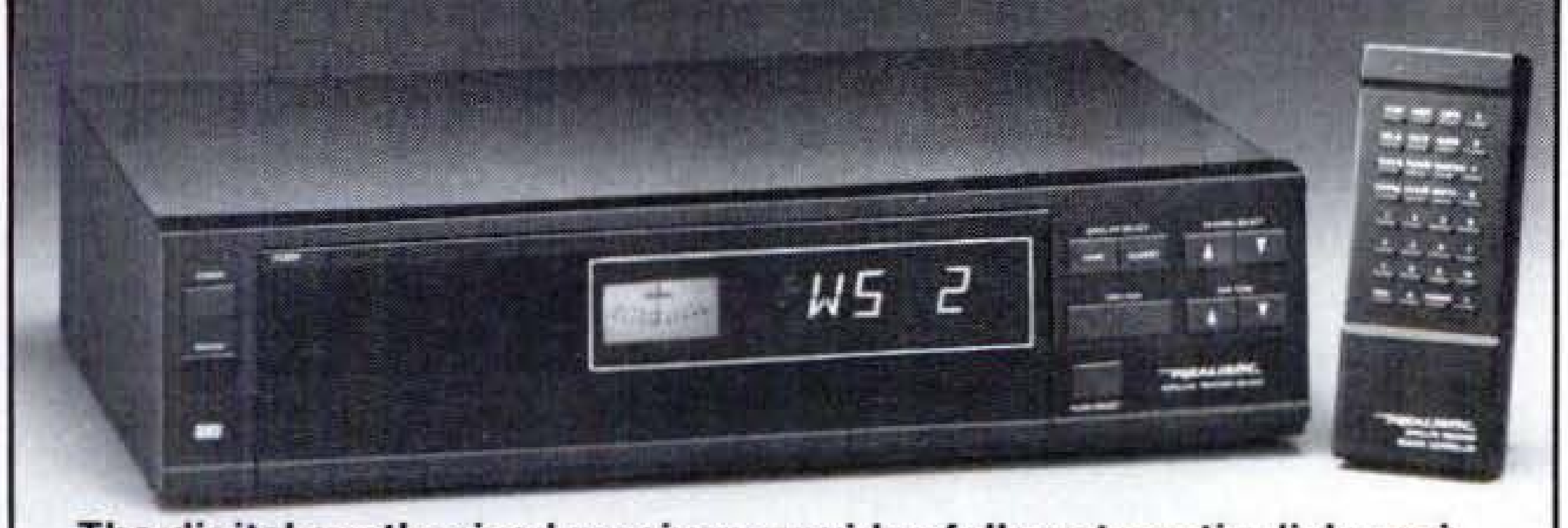

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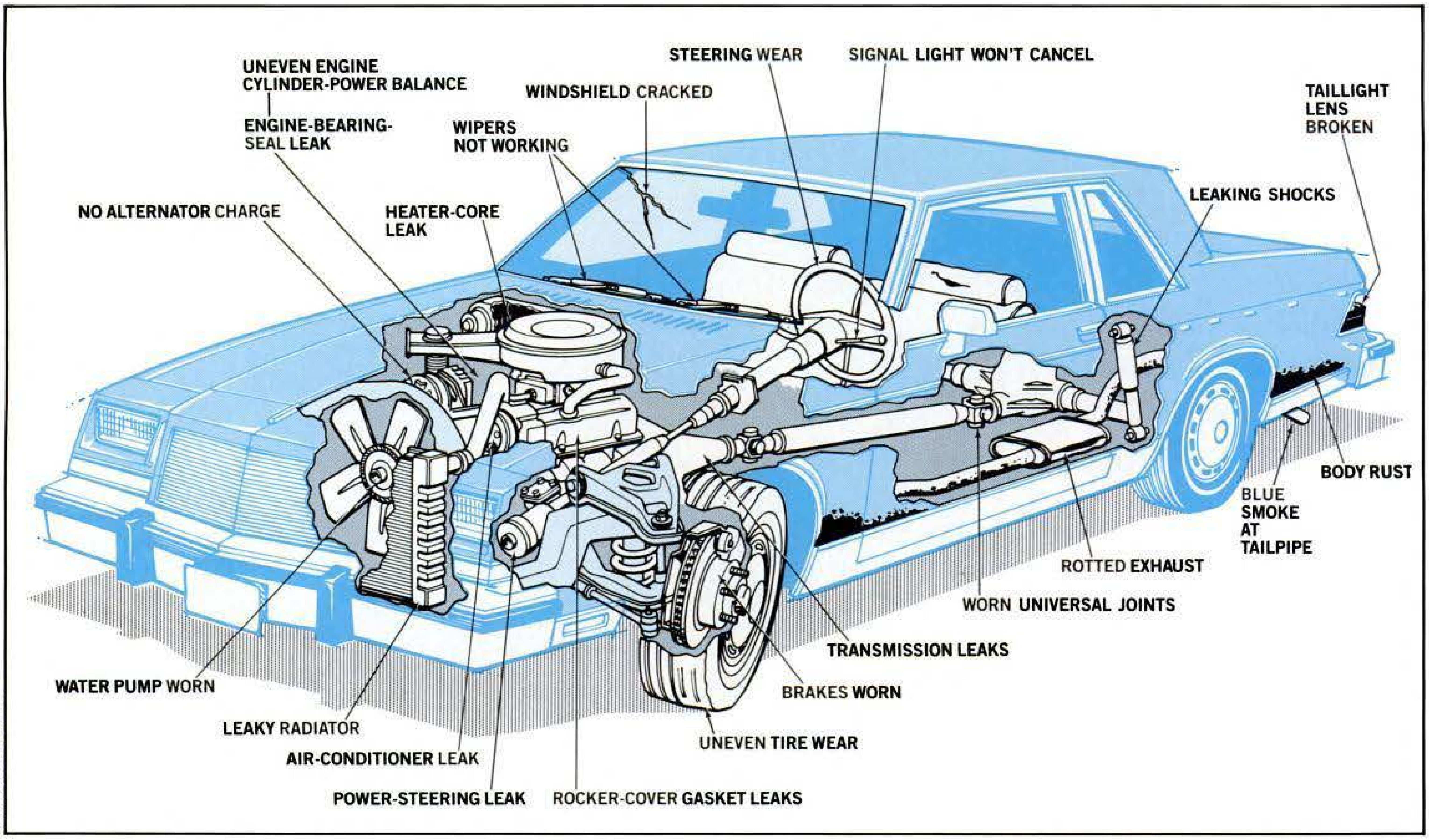
Used-car checklist

—a pro tells how to inspect a car before you buy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DRAWINGS BY TOM MOORE

There's a lot more to weeding out a lemon than simply kicking the tires. A detailed inspection is a wise preliminary before you decide whether to buy—or keep on looking.

By BOB CERULLO
Drawing by Russell von Sauers

If you're planning to buy a used car, you're not alone: Almost 17 million of the 26.9 million cars purchased last year were used. With the price of the average new car hovering around $10,000, it's no wonder that so many people choose to take the used-car route.

To make an intelligent purchase, however, you have to assess the risks in buying a particular car. The drawing above points out common problems that can plague a used car, and on the following pages I list the major areas I check when a client brings a car to my garage for evaluation. You can make most of these checks yourself. The accompanying checklist helps you tally up a car's approximate value as you look over its components.

Road test. Get behind the wheel and start the engine. The starter shouldn't make any grinding sounds. The car should start easily. Drive the car forward, and test the brakes. Will it stop safely? OK, then head onto a quiet road for a transmission-shift test. Starting from a standstill, accelerate modestly. With an automatic transmission, listen for shift changes from first to second and from second to third gears. At about 35 mph, shift the gear selector to the next lower range. You should feel a smooth gear change if the transmission is working properly. If the car has a standard transmission, run through all the gears. Observe how easily you can select each gear. Make sure you can accelerate without jerking or slipping. Finally, any loud whine or grinding noise that changes as the shifts occur indicates a problem.

Now check the brakes. Hold the steering wheel loosely, and hit the brakes. The car should not pull to one side. There should be no squeal or grind, and the pedal should feel firm. The parking brake should keep the car from rolling.

Next, consider how the car steers.

Continued

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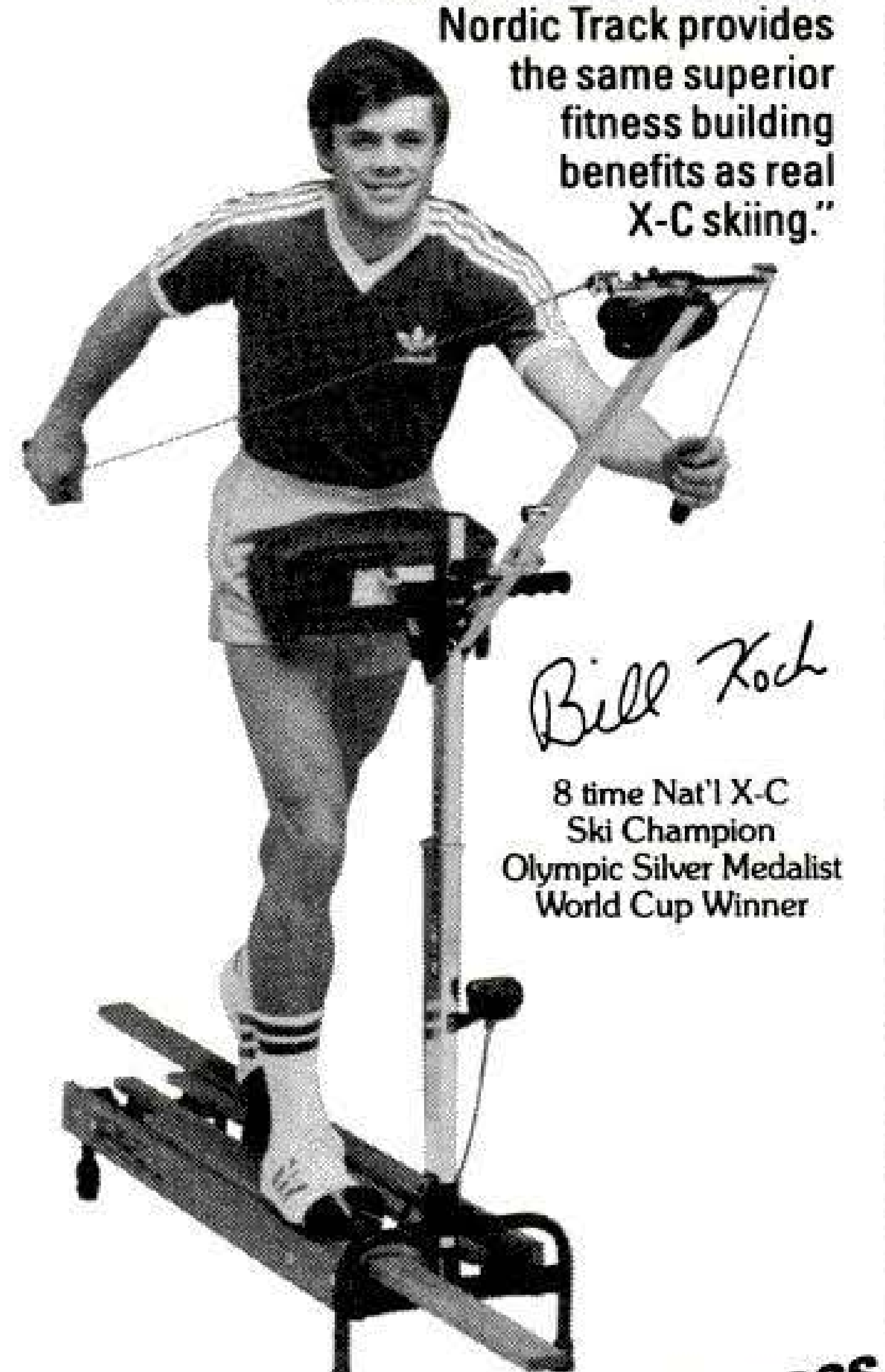

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Holding the steering wheel loosely again, check for steering pull to either side. (You must be on a level road; a crowned road will cause the car to pull to the side.) The car should steer straight. There should be no binding or grinding when you turn the wheel. The steering-wheel position should be centered when you're on a straight road. Finally, check to be sure there is no noticeable free play in the steering wheel. Now you're ready to take a look at the car's various systems.

Engine checks. The engine should hum; any clicking noise from the top part of the engine indicates probable valve-train troubles. With the transmission in neutral, race the engine momentarily. If you hear a loud knocking noise, it could mean worn bearings. Watch the color of the exhaust. Blue smoke from the tailpipe is a clue to a costly-to-repair oil-consumption problem; black smoke indicates a fuel problem. White vapor may mean a leaking head gasket. Check the engine-oil dipstick. A dipstick covered with a blackish, creamy substance can tip you off to moisture in the crankcase.

If you have a pair of insulated spark-plug-wire pliers and a dwell tachometer, you can do a cylinder power-balance test. This essential test will tell you whether any cylinders have problems that could be expensive to fix. Connect the tachometer to the running engine. Using the insulated pliers to protect you against an electrical shock, disconnect and ground each of the spark-plug wires, one at a time, for a few seconds, then reconnect them. As you remove each wire, engine speed should decrease by 25 to 50 rpm. If it doesn't change, you've found a cylinder that isn't firing.

Fluid leaks. Look carefully at the engine rocker-arm-cover gaskets, the engine front and rear main seals, the oil-pan gasket, the steering gear, and power-steering pump. What may seem like just a bit of fluid could be the sign of a costly-to-repair oil leak.

Transmission. It's important to check the transmission and differential for leaks. Also, remove and check the transmission fluid-level dipstick. One of the first signs of impending transmission trouble is dark brown and foul-smelling burnt transmission fluid.

Steering and suspension. Irregular tire wear is the best clue to a wheel-alignment problem, but odd wear on the tires can indicate steering-linkage problems as well. A tire with half the tread in good condition and half nearly bald would indicate a wheel-alignment problem. Front tires with bumpy or gouged treads could indicate a steering problem. Look for worn upper and lower control-arm bushings. Check upper and lower ball joints. Remember to look over the springs and shock absorbers. Broken leaf springs must be replaced. Broken or oil-soaked shock absorbers or MacPherson strut-type shocks will also need replacement. Don't forget to check for excessive power-steering free play while the engine is running.

Brake checks. Pump the brake pedal with the engine off. Then press down on the pedal and start the engine. If the power brake is working, the brake pedal will drop just a bit. Press firmly on the brake pedal again, holding it for 60 seconds. The pedal shouldn't sink. If it does, you may need a brake master cylinder. Examine the thickness of the brake pads ["Trouble-Shooting Disc Brakes," PS, May '85] or brake shoes ["Trouble-Shooting Drum Brakes," PS, July '85]. Check the brake drums or disc rotors for scoring. Check for binding disc-brake calipers by placing the car on jack stands and having an assistant press the brake pedal. You shouldn't be able to turn the wheels. When the brake is released, the wheels should turn freely. If they don't, the calipers are binding and need repair. Look over the brake hoses for cracks. Make sure the parking-brake cables work freely.

> *"The cylinder power-balance test is the most important element of your used-car check"*

Cooling system. With the engine warm, look over the hoses, radiator, and engine for leaks. Any powdery, greenish-white residue is a sign of coolant leaking. Look around the base of the water pump and under the engine for leaks. Also check for leaks around as many of the engine's core plugs as you can see. With the engine off, grasp the engine fan and try to rock the water pump. If the water-pump pulley moves, you will need a new pump. Drops of antifreeze on the passenger-side rug signal a heater-core leak.

When the engine is cool, remove the radiator cap and look at the coolant. Rusty coolant warns of a serious corrosion problem. A strawberry-milkshake color indicates a transmission-cooler leak.

Battery and electrical system. Some batteries have a built-in hydrometer;

when a yellow warning eye shows, it means that the battery must be replaced.

You can perform a simple test to tell whether the alternator is charging the battery by connecting a voltmeter across the terminals of the battery. With the engine shut off, the voltmeter should read 12 volts. With the engine running, the voltmeter should read 13 or 14 volts—if not, the alternator isn't charging.

Switch on the headlights. Check the high and low beams. Make sure the parking lights work. Check all the signal lights. Make sure the signal-light switch cancels after the steering wheel is turned back to the straight-ahead position; the switch is expensive to replace. Test the brake lights. Be sure the emergency lights flash.

Generally, a new light bulb will correct most problems with a car's lights. However, an inoperative four-way flasher or a malfunctioning brake light can mean a costly repair. Dim lights or burnt fuses nearly always mean wiring trouble that will have to be traced and corrected. Parking-light, taillight, and back-up-light lenses must be in good condition to pass inspection in several states.

Turn the key to the "ignition" position. Both the oil-pressure light and the alternator light should glow until the engine is started. The engine-temperature and brake warning lights should illuminate when the key is at the "start" position. On General Motors cars built since 1981, a yellow CHECK ENGINE light should come on when starting and should go out when the engine is running.

Heater and air conditioner. Flip on the heater to be sure it produces hot air at all blower speeds. Check the defroster—and the rear-window defogger, too, if the car is equipped with one.

Switch on the air conditioner to see whether cold air comes out of the dashboard louvers. This air should be about 20 degrees F lower than the outside temperature. The air-conditioner evaporator inlet pipe should be ice cold to the touch when the system is cooling. If the air conditioner is empty of refrigerant gas, the compressor, condenser, evaporator, or a line may be leaking.

Body checks. Look for signs of rust around wheel wells, window trim, and at the base of doors. Rust is a cancer that is difficult to control; if a door panel or fender is rusted through, the only sure cure is a new one.

Dents and scratches can be deceiving. You cannot simply spray paint over a scratch. It must be primed,

Continued

SMART AUTO ADVICE

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I've seen how dirty deposits can hurt a carburetor–and gum-up an engine. But what most folks don't know is how little it really takes. Or how fast those harmful deposits accumulate.

Experts say it takes dirt that's only one-thousandth of an inch thick to cripple a carburetor jet. And that thin layer of dirt can quickly become a dirtier, gummier mess.

A mess that'll settle in your carburetor. A mess that could make your car stall. Run rough. Start hard. A mess that'll creep into the PCV Valve, and cause rough idling. Acid corrosion. And heavier than normal oil and fuel consumption.

And because these dirty areas are so hard to see–and reach–most folks figure a costly professional cleaning is the only way to wipe it out.

But what I recommend is a really powerful jet spray cleaner. Jet-Spray Gumout® Carburetor & Choke Cleaner. It's preferred 3-to-1 over any competitor. And believe me, it's for a lot of good reasons.

It gets to the gum and dirt. And cleans up your carburetor and choke like no other cleaner. With regular use, I've found you can keep your carburetor and choke virtually dirt-free–and that means saving gas, money, even the life of your engine.

Just spray Jet-Spray Gumout® on the outside of the carburetor. On the carburetor linkage. On the automatic choke. And on the inside of the carburetor throat. After that, spray it directly into the open end of the PCV Valve.

As it cleans your carburetor and linkage, it helps to stop that rough-running and stalling.

As it cleans the inside of the carburetor throat, it helps to stop that rough idling.

As it cleans the choke, it keeps it from sticking.

And finally, as it cleans your PCV Valve, your engine can start giving you a cleaner, better performance.

So for engine dirt that's quick-to-form *and* hard-to-reach, I recommend Jet-Spray Gumout® Carburetor & Choke Cleaner.

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sanded, and re-primed before the final spray. Fixing even the smallest scratch or dent takes time, and this means money. Also, remember that a cracked windshield will not pass inspection in many states.

Exhaust system. The entire exhaust system—from the engine to the tip of the tailpipe—should be checked. Rotted-out exhaust parts will soon need to be replaced. If there are any loud noises, find out where they are coming from. Don't overlook the possibility of a cracked exhaust manifold. Check to see that the catalytic converter hasn't been removed; it's a costly item to replace.

When to rely on a pro. If you don't perform a cylinder power-balance test yourself, have one done by a professional mechanic. It tells you whether any cylinders have costly defects. Using an engine analyzer, a competent mechanic can determine whether the car is firing evenly on all cylinders, and can warn you of bad valves, low compression, carburetion problems, defective ignition wires, vacuum leaks, and a host of other conditions. A passing grade on the cylinder power-balance test is the most important element of your used-car check.

Your mechanic can also test the car's exhaust emissions. It's important to know that it will pass your state's emissions inspection. Flunking the test could mean fuel-system repairs that could cost hundreds of dollars.

Further information. Recently enacted regulations require dealers selling used cars to attach a sticker to each car stating the terms of any repair warranty that is included in the price of the vehicle. Look for this sticker; it also advises the buyer to have the car checked by an independent mechanic. The Federal Trade Commission (Box 37041, Washington, D.C. 20013) offers a guide to used-car warranties and mechanical inspections called "Used-Car Buying: A Checklist." It is available free from the commission.

Prices of used cars are listed in the "NADA Used Car Value Guide," which is available from NADA (8400 Westpark Dr., McLean, Va. 22102-9985). A subscription costs $29 per year.

For information on car-repair costs, consult *The Consumer Cost Guide to Car Repair,* by Larry Conroy and Paul O'Connell (Prentice Hall, Englewood Cliffs, N.J. 07632: $6.95, paperback; $13.95, hard-cover).

The federal government also maintains a toll-free hot line providing information on car models affected by safety recalls. The telephone number is 800-424-9393. PS

To buy or not to buy

Using this checklist, tally up the defects you find during your inspection. It will help you determine whether the car is a good buy, a possibility for a do-it-yourselfer, or a clunker to steer clear of.

Compare the total number of points with the values listed below. There are always exceptions, but generally the guide will give you a good idea of which cars to consider—and which ones to avoid.

Areas where repairs are needed

Overall body condition		
Minor body work	20	☐
Side glass, each	30	☐
Windshield	35	☐
Major body work	50	☐
Repaint body	50	☐
Seats/carpets	50	☐
Vinyl top	50	☐
Rusted sheet metal	100	☐
Transmission		
Fluid leaks	15	☐
Differential	25	☐
Torque converter	25	☐
Overhaul	55	☐
Mileage		
Over 70,000	50	☐
Over 100,000	100	☐
Over 150,000	200	☐
Engine		
Major tuneup	5	☐
Camshaft	25	☐
Timing chain	25	☐
Valve job	25	☐
Carburetor	30	☐
Crankshaft/bearings	35	☐
Low oil pressure	50	☐
Rebuild	100	☐
Brakes		
Reline brakes	10	☐
Calipers/cylinders	15	☐
Master cylinder	15	☐
Rotors/drums	15	☐
Steering/suspension		
Ball joints	10	☐
Power-steering hoses	10	☐
Shock absorbers	10	☐
Steering linkage	10	☐
Bushings	15	☐
Power-steering pump	25	☐

Steering gear	25	☐
Air conditioner/heater		
AC control	10	☐
Blower motor	10	☐
Heater core	10	☐
Hoses	10	☐
Condenser	30	☐
Compressor	35	☐
Evaporator	35	☐
Cooling system		
Hoses	5	☐
Radiator	10	☐
Water pump	10	☐
Core plugs	15	☐
Oil leaks		
Differential-pinion seal	5	☐
Valve-cover gaskets	10	☐
Timing-cover seal	15	☐
Engine main seals	25	☐
Oil-pan gasket	25	☐
Exhaust		
Muffler	5	☐
Tailpipe	5	☐
Engine pipe	10	☐
Exhaust manifold	10	☐
Catalytic converter	25	☐
Electrical		
Battery cables	5	☐
Interior lights	5	☐
Signal lights	5	☐
Alternator	10	☐
Battery	10	☐
Starter	10	☐
Taillight lens	10	☐
Wiper motor	10	☐
Radio	25	☐
Electric windows	30	☐
Major wiring	75	☐
Total points		___

How it all adds up

Total points	
0 to 20	Excellent value, may be worth more than top book value.
21 to 30	Good value, worth top book price.
31 to 75	Pretty good at trade-in price.
76 to 150	OK if body is clean and rust-free, and price makes cost of repair worthwhile.
151 to 375	Fair value, but only if price of car is a few hundred dollars less than book value minus cost of repair.
376 to 500	Poor value, risky to buy if you don't do most of your own major repairs. Price must be low even for experienced DIY to consider.
501 to 599	OK if you do your own major repairs and get car for less than ⅓ of book price. Otherwise, forget it.
600 and up	Do not accept this clunker, even as a gift from a little old lady who only drove it to church on Sunday.

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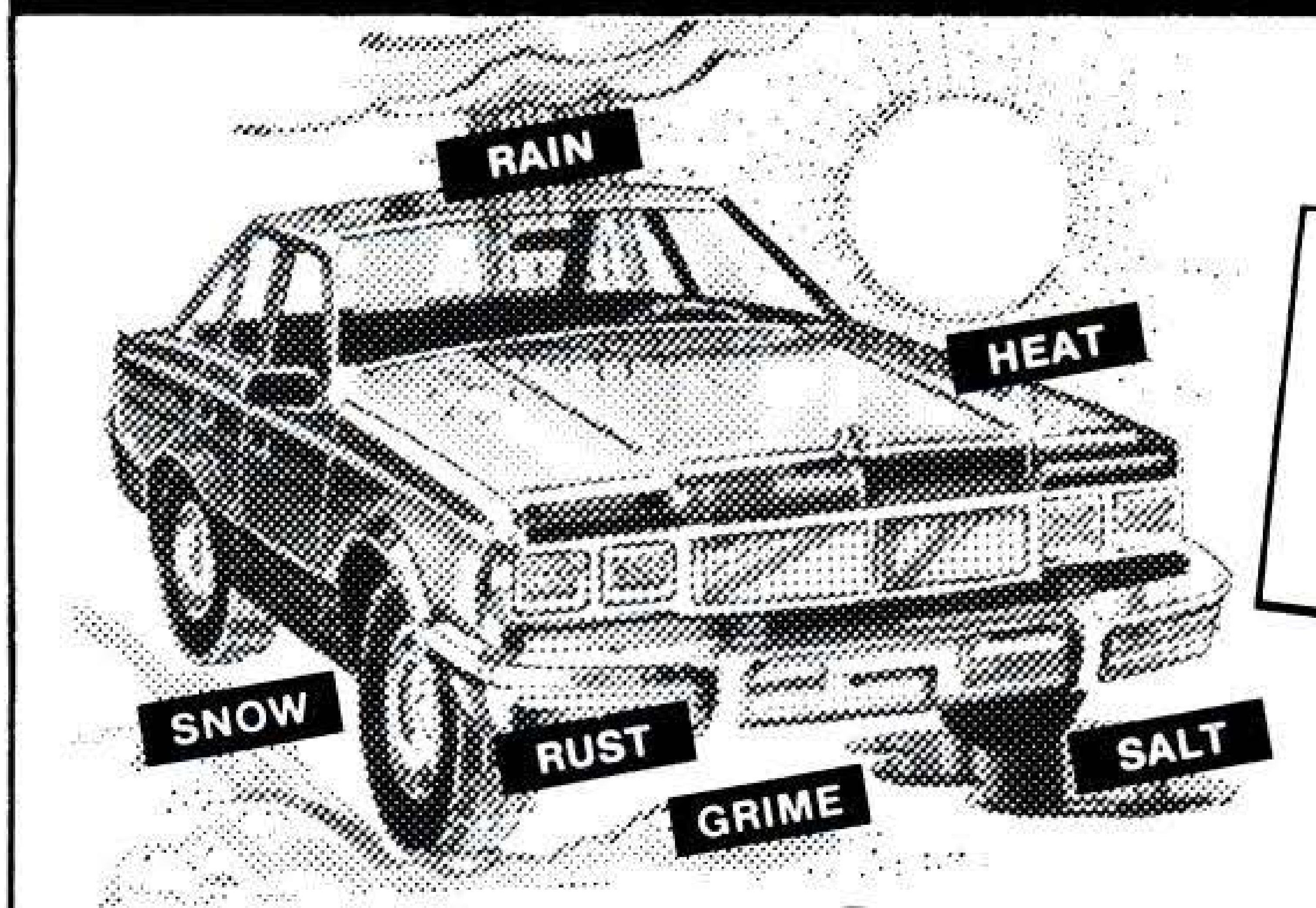

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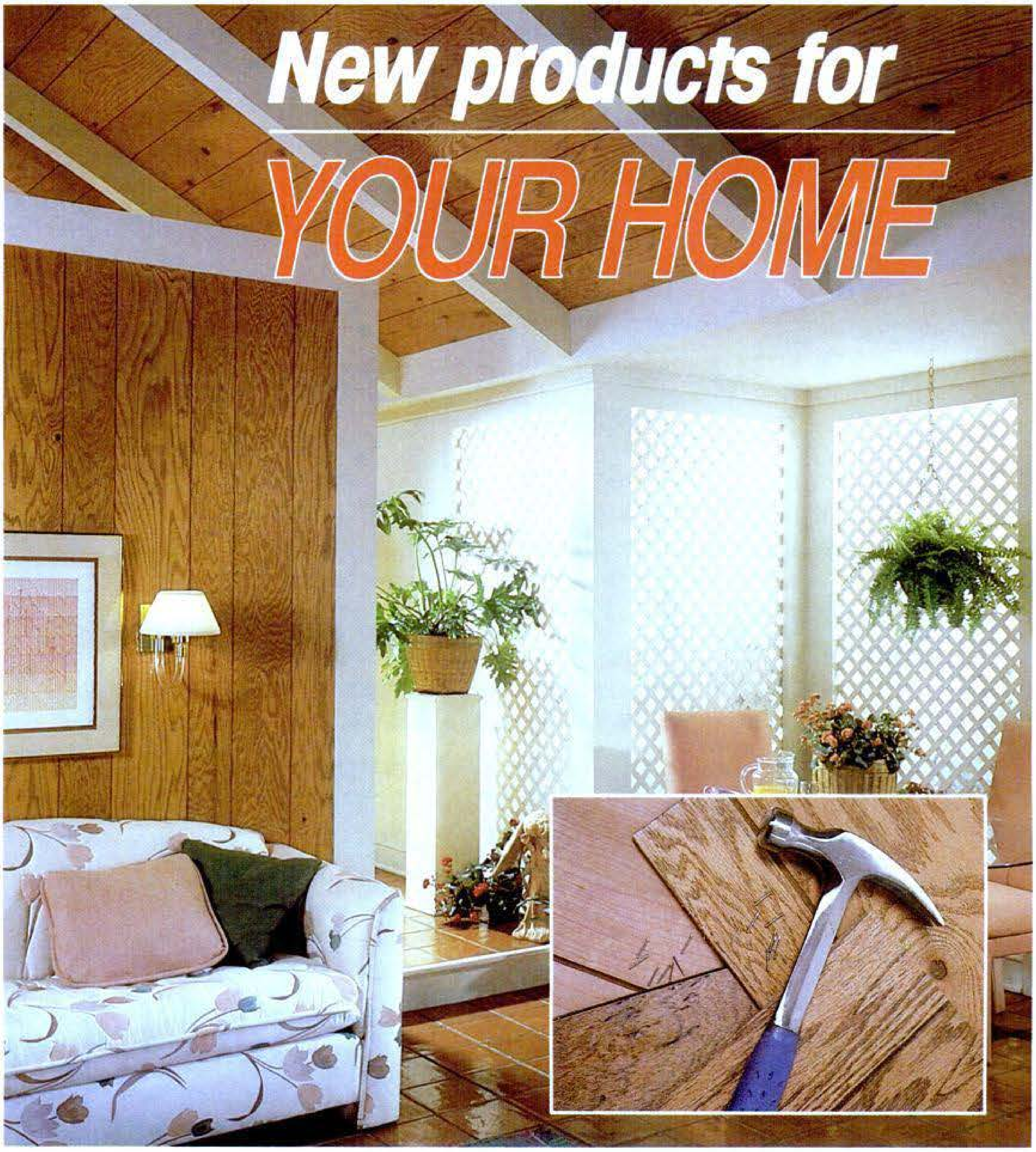
A PS SPECIAL SECTION

New products for YOUR HOME



Vigorous veneers enliven plywood panels

Spring cleaning may be old-fashioned, but everybody wants to spruce up the house after the long winter. The products featured here can make refurbishing a pleasure. They range from handsome new wall paneling to a leakproof water heater and more-efficient recirculating pump.

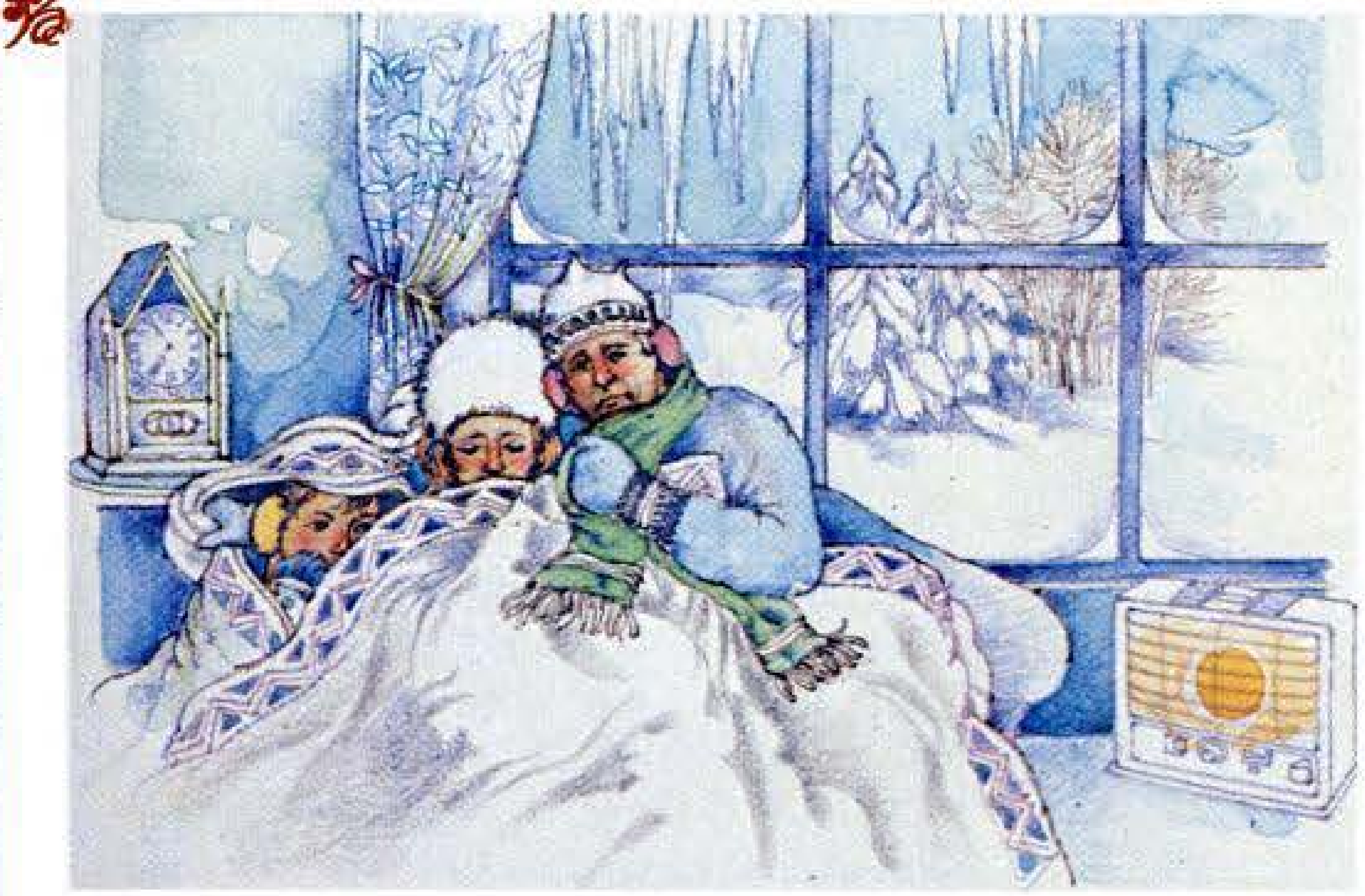
Plywood panels are coming out of the attic and the basement—and even the rec room. Homeowners have traditionally covered up ugly walls in these hard-knock rooms with 4-by-8-ft. prefinished panels.

But despite their durability and relatively low price (compared with tongue-and-groove lumber), these panels look like, well, plywood panels. Even those faced with wood veneer instead of a printed pattern look slightly fake.

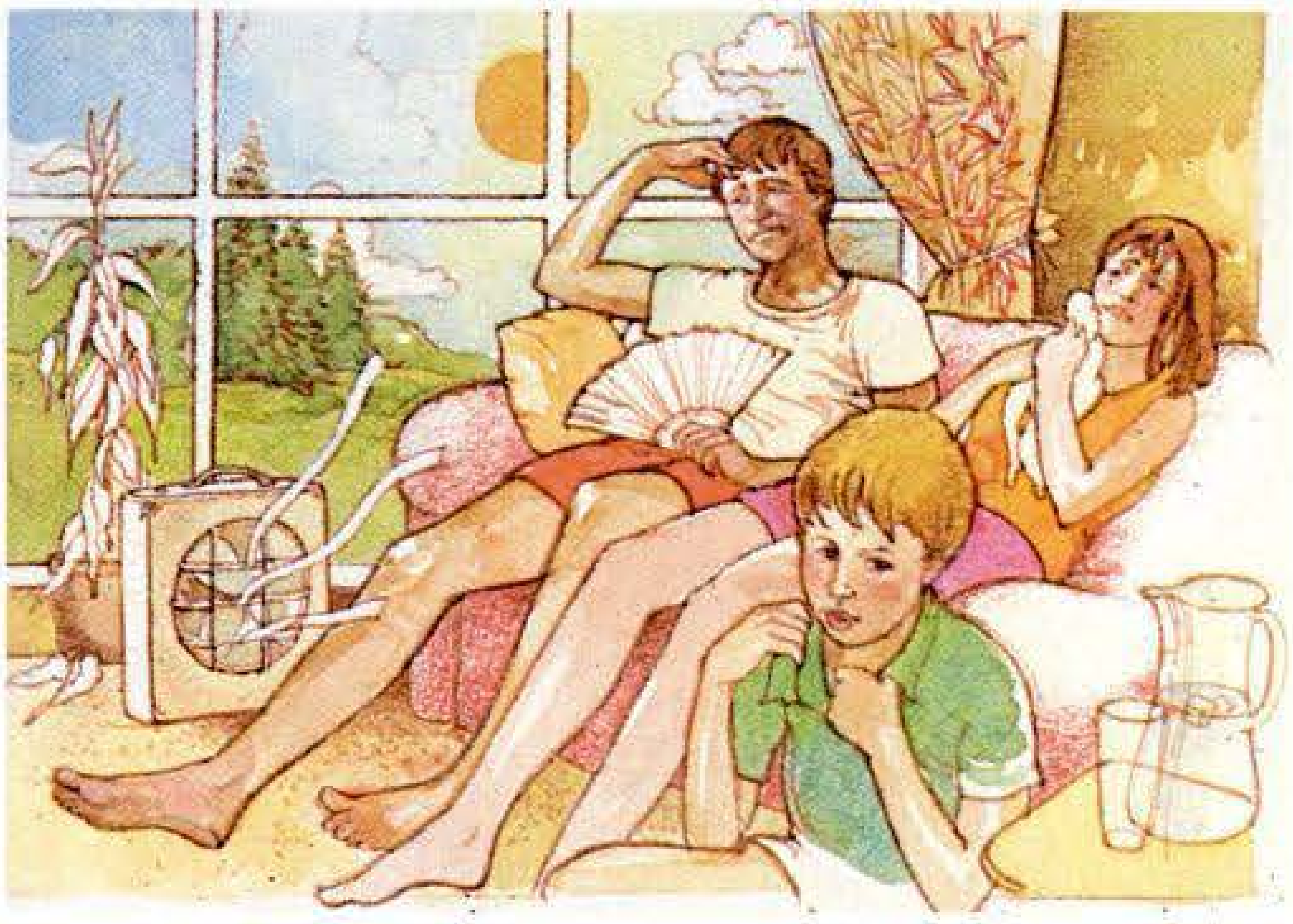
Continued

The insulator that really is a window.

or presenting Transparent Insulation from Ford Glass.



"Some windows are too cold."



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Some windows let precious warmth escape when it is cold outside and let in too much heat during hot weather.

But Sunglas HR glass lets the winter sun's heat inside and keeps it in. Also, the window surface will stay warmer reducing harmful condensation and drafts.

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Sunglas HR makes great energy sense for sunspaces. In fact, the larger your glass area, the more you need Sunglas HR.

For your comfort and convenience, ask for Sunglas Heat Reflective glass by name. It's backed by a 5 year limited warranty from Ford Glass, the second largest glass manufacturer in North America.

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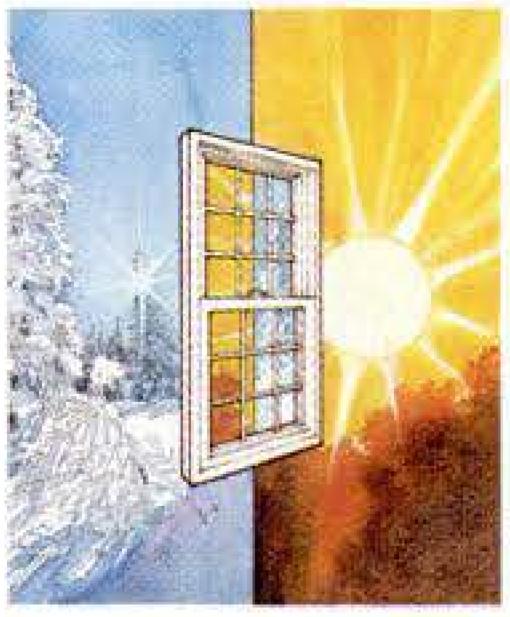

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*Based upon ½" air space. Performance will change with the width of the air space.

Now at least one manufacturer is using new technologies to make prefinished veneer panels that look much more like the tongue-and-groove wall paneling they imitate. Some of the new panels are even good-looking enough to serve as an accent wall—or ceiling—in a living or dining room.

"Consumers hate that black line between the strips of veneer on the panels," Doug Traub of Georgia-Pacific Corp. told me. According to Traub, Georgia-Pacific developed the Great Woods Collection of prefinished panels in response to consumers.

"We got rid of the black-painted, straight-channel groove," Traub said. "Now we have a V-cut groove between the veneers. It's tinted to match the finish instead of painted flat black. That makes the panel look more like tongue-and-groove boards."

The milled groove separates veneer strips glued to a plywood substrate. The new panels have two fewer strips of veneer per panel—six instead of eight. None of the strips on any one panel is the same width. And none of the veneers match. This is different from the repeating pattern of matched veneers in alternate widths seen on most veneer panels.

"We want the panels to look more like actual boards that you pick up at the lumberyard," Traub said.

The result is a rich-looking wood-grained panel (see photos). The new V-cut groove is indeed more subtle than the old black channel. "But it's too straight," said one PS staffer who had just installed tongue-and-groove wall paneling at home. "No piece of lumber has that perfect a cut line."

But for those who can accept almost perfect verisimilitude, the Great Woods Collection offers a wide variety of wood finishes for about $28 per panel.—*Susan Renner-Smith*

New products for
YOUR HOME

Faster finishes

Staining and finishing wood takes time. It's not hard to apply a few coats of stain and a few more of varnish. But waiting for each coat to dry can stretch the job of finishing a simple piece of furniture over many days.

Now at least two makers offer premixed stain-and-varnish combinations that cut finishing time drastically. Minwax's new Polyshades ["What's New in Home Improvement," PS, June '85] was introduced last year, and UGL recently introduced ZAR Plus. Each comes in satin or gloss finish and in six basic colors.

I tried Minwax's Polyshades on another new product: a 2-ft.-wide, 5-ft.-long strip of adhesive-backed flexible oak veneer (maker: Quality Doors, 603 Big Stone Gap Rd., Duncanville, Texas 75137). I'd mounted this strip onto the aged plastic-laminate backsplash in my kitchen.

Following directions, I made a quick pass with a piece of extra-fine sandpaper over the flexible veneer to remove any finger oils. I applied a thin coat of Polyshades Honey Pine in the standard way, using several horizontal zigzags over a wide area. Then I pulled the unfilled brush straight down, with the tip barely touching the veneer. After several minutes, I checked for drips.

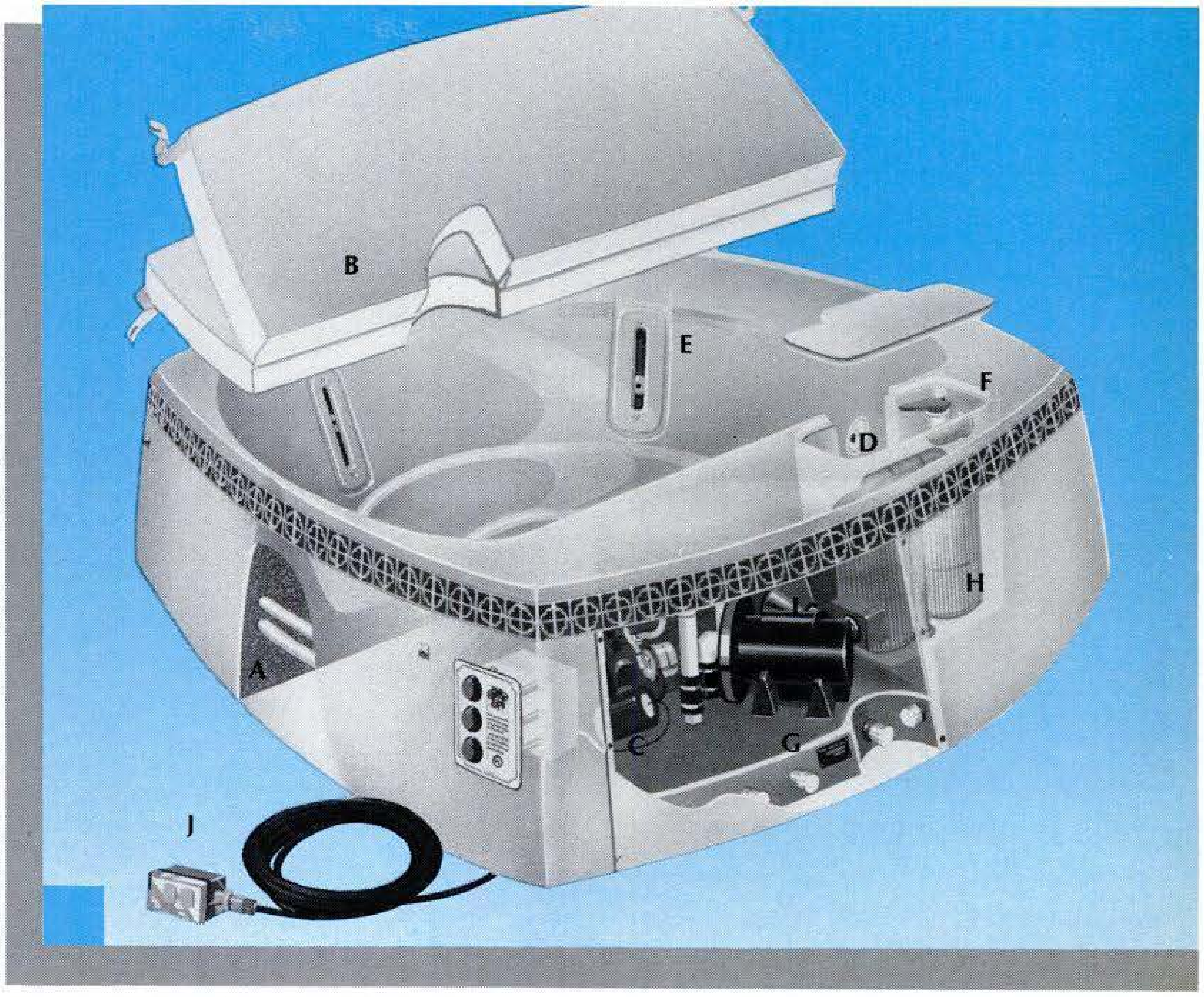
I let the first coat dry for eight hours, then rubbed the surface with steel wool and applied a second coat. After eight hours it looked great. But because the veneer is right behind the sink, I brushed on a third coat.

The final finish is all I could want—deep, clear, and durable. Fully six months later, the finish still glows, unharmed by constant splashes. (And the veneer is still stuck on tight.)

I also used Polyshades on birch kitchen cabinets from which I'd scraped and sanded 35 years worth of paint. Following the suggestion of a Minwax engineer, I used a disposable foam brush so I could lift the finish out of corners and around moldings, where it tended to puddle. Again, I applied three coats—and was rewarded with a rich, lustrous finish that makes the beat-up cabinets look almost classy.—*Susan Renner-Smith*

A SPA IS A SPA IS A SPA?

A CONSUMER GUIDE



If you've been considering a spa or hot tub you're probably already aware of the benefits and pleasures of whirlpool massage. However, not all spas and hot tubs are alike. The true test of any spa is whether it can provide these pleasures conveniently and efficiently. We'd like you to know what to look for when shopping for a spa and show you why the engineers who designed the HOT SPRING SPA have produced the best one available today.

1. MATERIALS AND CONSTRUCTION.

The HOT SPRING SPA is made of the most advanced and durable material of any spa—ROVEL™ This high-impact plastic is superior to wood of old fashioned hot tubs because it doesn't absorb water, leak or deteriorate. Unlike fiberglass or acrylic surfaces, ROVEL won't peel, blister, crack or delaminate. Check the warranties of other spas and you'll see that ROVEL is guaranteed to be much more durable than any other spa material. In fact, a recent industry trend has seen many acrylic manufacturers reduce surface warranties to just one year! ROVEL is softly textured so you won't slip when entering or exiting the spa.

2. CONVENIENCE AND EFFICIENCY.

Most spas and hot tubs have very little thermal insulation, some have none at all! Just how important is insulation? It's the most important feature in private spa ownership! Uninsulated spas will physically not operate outdoors in colder climates, making spa use as seasonal as a swimming pool. Further, a marginally insulated spa forces the heater to run continuously, costing you money. The HOT SPRING SPA is FILLED SOLID with over 130 lbs. of polyurethane foam insulation **(A)** and standard equipment includes a 3½" thick insulating cover **(B)**. This heavy insulation makes it economical to keep the HOT SPRING SPA heated to your desired temperature 24 hours a day, regardless of location. You can use your HOT SPRING SPA at any time day or night, in any weather, and for just pennies.

3. TEMPERATURE.

Precise temperature control is important. A spa should control temperatures within ±1°F. or you'll forever be too hot or too cold as the water changes temperature. The HOT SPRING SPA achieves this accuracy by using a "precise demand" thermostat with its sensor in intimate contact with the water **(C)**.

4. HYDROTHERAPY JETS.

Vigorous jet action is the key to true hydrotherapy. Only the HOT SPRING SPA gives you the option of powerful fixed jets (22 psi at each jet) **(D)**, and the unique massaging effects of MOTO-MASSAGE™ The exclusive MOTO-MASSAGE (U.S. Patent #4,523,340) glides gently up and then down the entire length of your back in a continuous sweeping motion that simulates the natural stroking of a manual massage **(E)**. In addition, we provide an air control which can be reached from inside the spa so you can vary the intensity of the jets **(F)**. These features combined with the STA-RITE Max-E-Glas pump provide the best hydrotherapy available today **(G)**.

5. WATER CHEMISTRY AND FILTRATION.

Most portable spas contain less than 180 gallons of water. It is difficult to maintain proper chemistry in such a small body of water. Therefore it is necessary to drain them more frequently than the HOT SPRING SPA which contains 275 gallons. Good filtration is essential in any spa, but in other portables, it has been overlooked. The HOT SPRING SPA has the largest capacity filter of any portable spa—50 square feet **(H)**. It requires attention only 2 or 3 times a year. Its top-loading design allows you to inspect, remove, and clean it without draining the spa.

6. LIGHT FOR NIGHTTIME USE.

Another feature of the HOT SPRING SPA is the underwater light **(I)**. It's dimmer controlled so it's never too bright or too dim, and different colored bulbs can be used for different effects.

7. NO INSTALLATION.

Simplicity of installation should be checked. An in-ground spa is the most difficult, usually requiring backyard excavation, building permits and an expensive installation crew. Hot tubs are not much simpler. The HOT SPRING SPA avoids these problems by requiring only common household current to operate (110v. 20amp.) **(J)**. There is no permanent hard wire electrical hook-up, no external plumbing to assemble, and no building permits to obtain. As a portable appliance, the HOT SPRING SPA will not increase your property taxes and you can take it with you when you move.

8. LISTED BY UNDERWRITERS LABORATORIES.

The HOT SPRING SPA is completely listed by Underwriters Laboratories, the recognized experts in testing for safety. The importance of correct and safe electrical design should not be overlooked. Check for the U.L. Mark on the outside of any spa you're considering—you'll see it on the HOT SPRING SPA.

We are proud of the quality features we build into every HOT SPRING SPA. The HOT SPRING SPA is an integrated design whose form follows function—the result of 9 years of evolution toward an ideal. So, before you buy any spa, be sure to see and test the HOT SPRING SPA. It has the features, performance, and quality you need.

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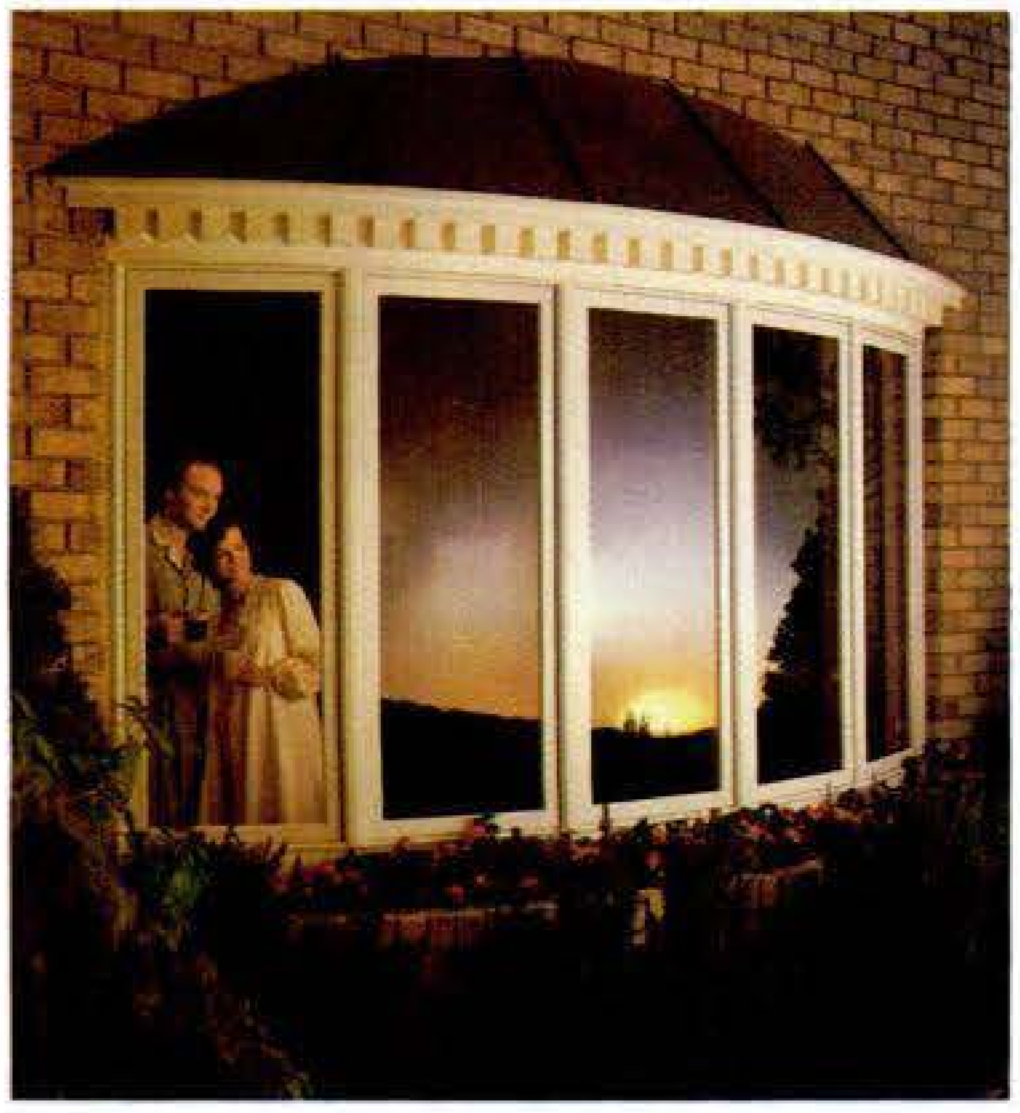

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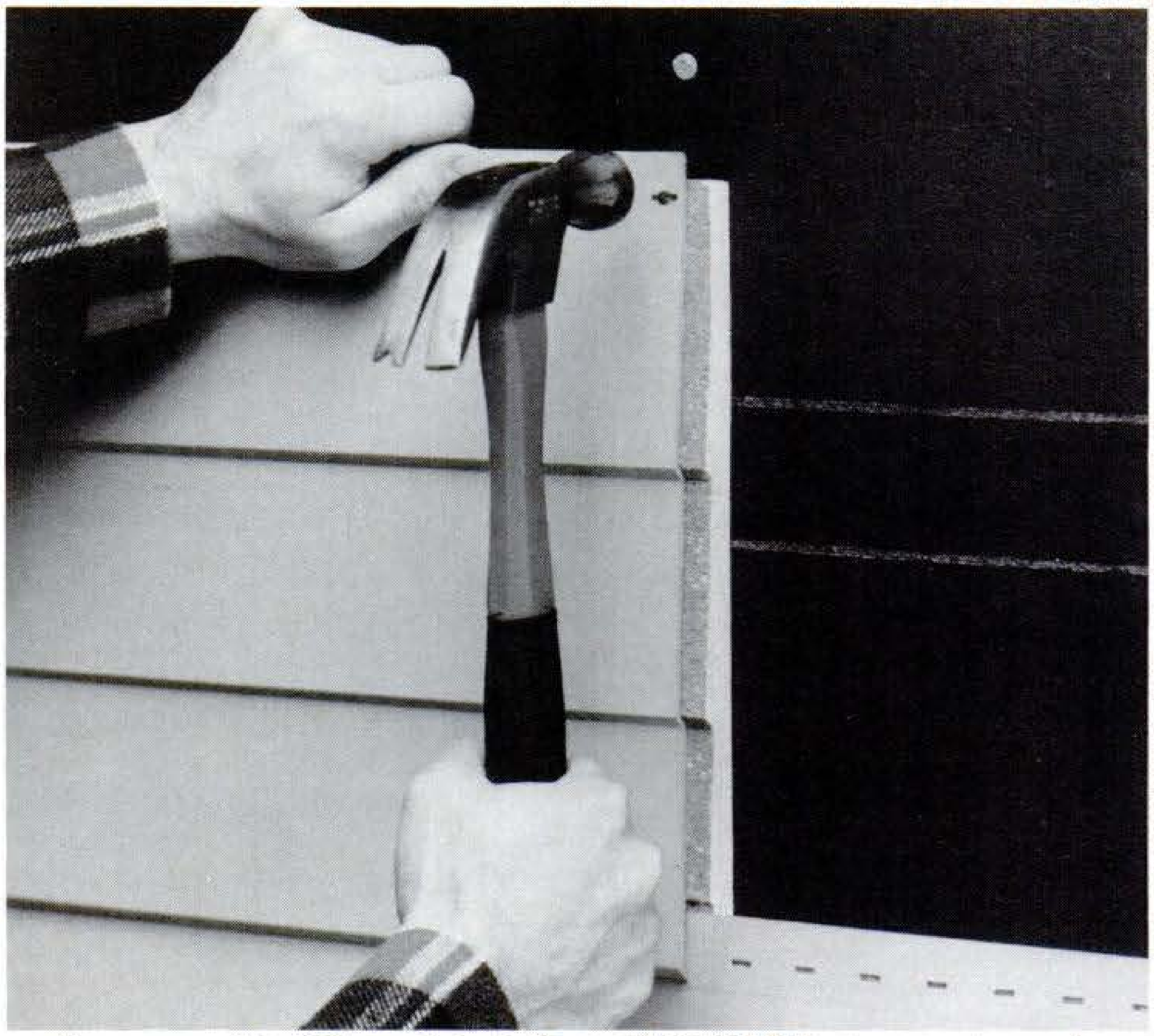
New products for YOUR HOME



R-5 siding

You stuff your walls with insulation, weatherstrip your windows, plug a setback thermostat into your furnace—all to improve your home's energy efficiency. Now you can extend your battle to reduce heating bills to your home's first line of defense against the cold: the exterior siding. Thermolock, an easily installed hardboard siding from Abitibi (3250 W. Big Beaver Rd., Troy, Mich. 48084), features something the maker claims other sidings don't have: insulation.

Thermolock's panels consist of cellulose-coated ⅛-in.-thick hardwood boards with an expanded-polystyrene-bead backing. The result is a 1-in.-thick durable panel that resembles conventional narrow-beveled lap siding, but has a thermal barrier with an R-5 insulation value. (The ¾-in.-thick panel rates an R-3.5.)

Why a cellulose overlay? "Wood exposed to the elements is a chief source of deterioration in some sidings," says Abitibi's Anthony Kornichuk. "By fusing a cellulose layer onto the boards, we protect them. The cellulose also gives the siding a smooth finish that's receptive to painting and staining. And it makes it easier to emboss wood grooves and textures."

Thermolock panels, which are available in two sizes, 12 in. or 16 in. wide (both come 16 ft. long), are easy to install over sheathing or directly to the framing. Each panel has a row of pre-punched nail guides. The panels' weathertight horizontal joints overlap, which hides the nails, protecting them from corrosion, another source of siding trouble. Vertical joints are butted.

To finish the pre-primed panels, use an exterior latex paint made for wood substrates. According to Kornichuk, prefinished panels that make retrofits even faster will be available in the spring, when Thermolock goes on the market.

At press time, there was no established price for Thermolock. "The price will be within pennies of similar-appearing wood products and aluminum siding," Kornichuk says. "Thermolock will cost more than vinyl siding, but it has features that vinyl siding can't match, such as insulation."
—*Richard Layne*

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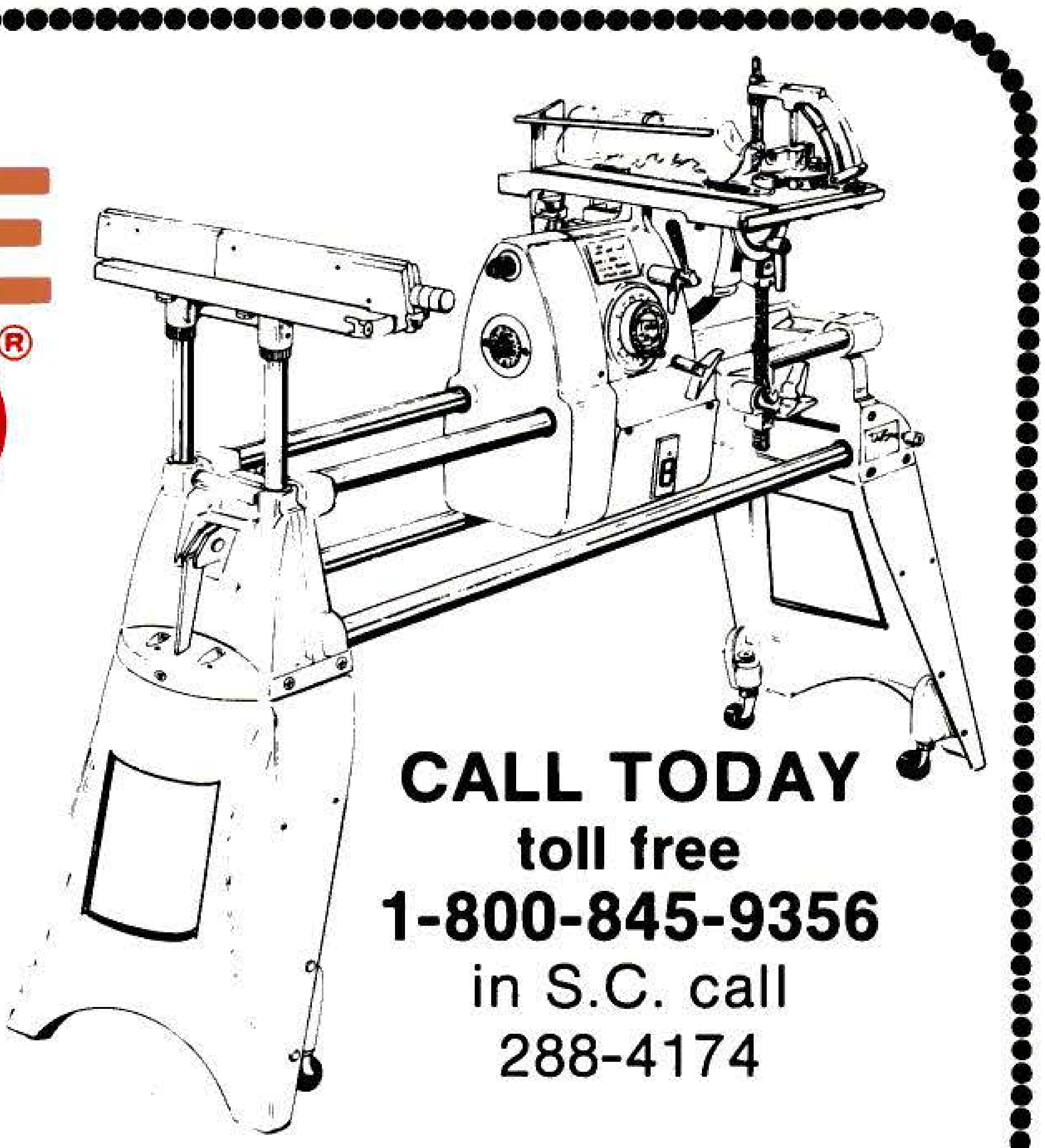

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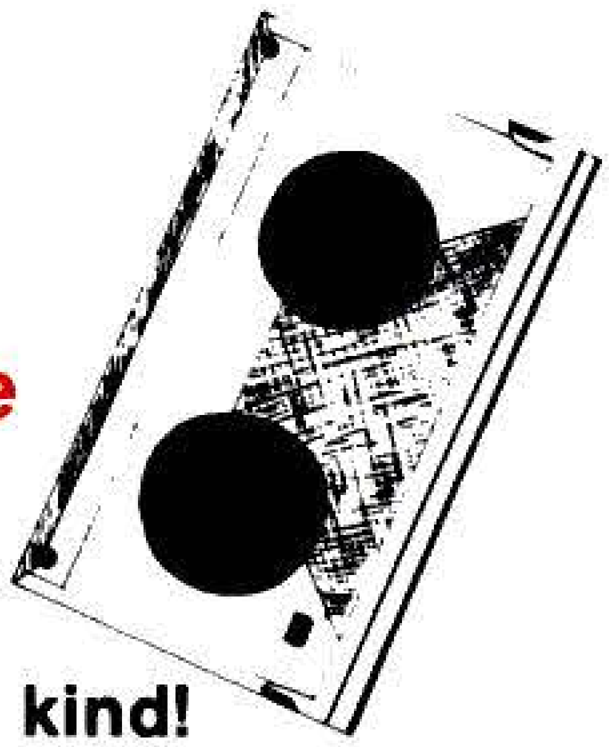

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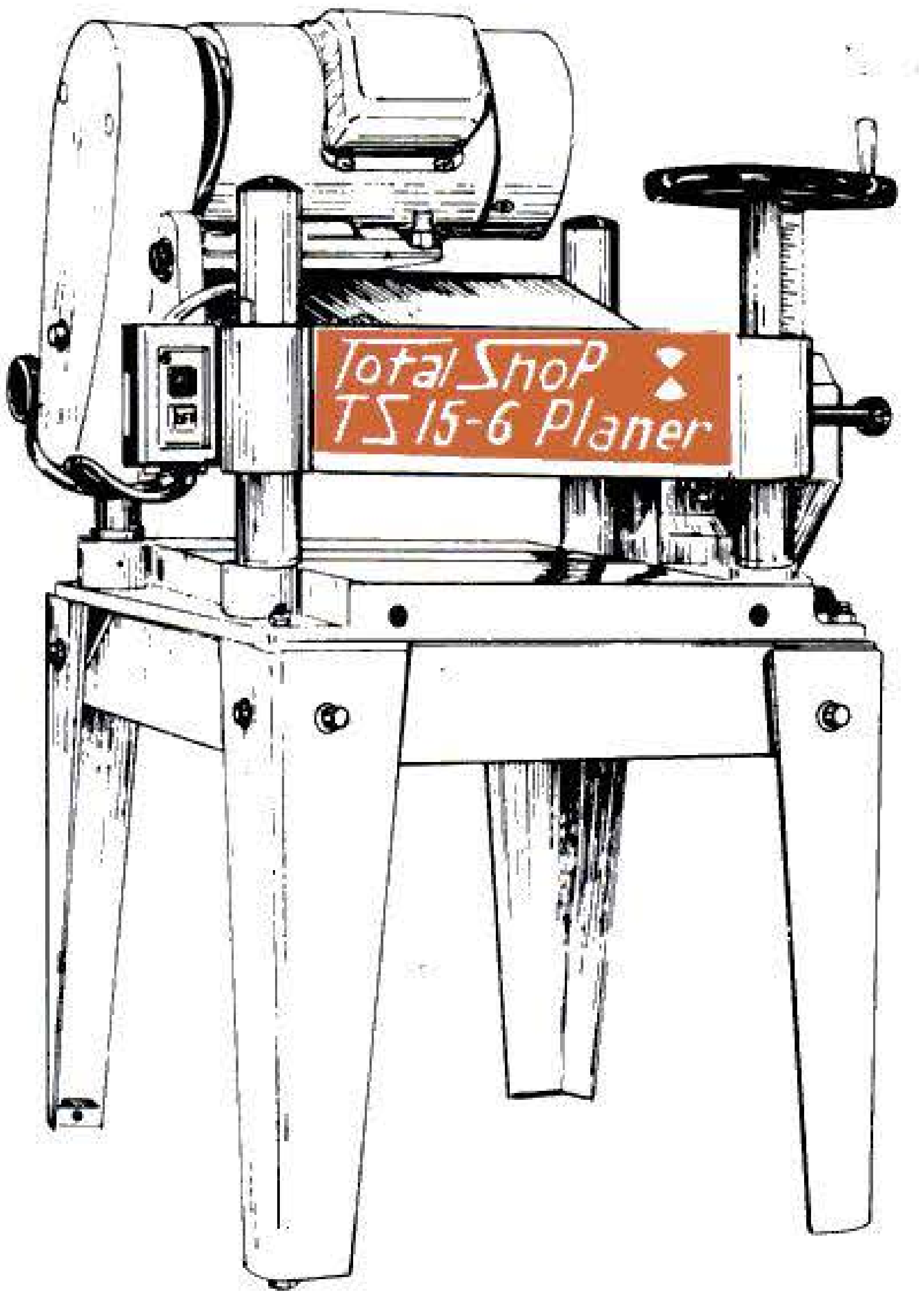

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New products for YOUR HOME

Hot water now, not later

Standing around with one hand stuck in the shower until the water gets hot enough is frustrating. Wasting a lot of water is more so. I solved these problems by installing a recirculating pump that continuously moves a small amount of water from the plumbing fixtures back to the hot-water tank for reheating. With this setup, the sinks and showers run hot right away.

The pump I installed is a new type just introduced in this country. The spherical-rotor pump, built by Laing Thermotech (632 Marsat Ct., Chula Vista, Calif. 92011), has only one moving part. There's no shaft, coupler, sleeve bearings, or gasket between the motor and pump. It never requires lubrication, and circulates water so quietly you can hardly tell the pump is running.

Conventional domestic water-circulating pumps are prone to a lot of problems: leaking seals between the pump and motor, seized bearings, and calcium buildup that impedes the flow of water. The Laing pump's innovative design eliminates these problems.

The only moving part in this circulator pump is the free-tilting spherical rotor-impeller (at the top of the cutaway pump in photo) that spins on a tiny, ultra-hard tungsten-carbide or ceramic ball. Sediment carried in the water cannot hang up the magnetically positioned rotor; it automatically tilts to allow the foreign particles to pass freely through the pump.

"Our unique single spherical-bearing arrangement minimizes mechanical energy losses," says Oliver Laing, president. "Where conventional motors and pumps require two sleeve bearings, we rely only on a small segment of a four-millimeter-diameter ultra-hard spherical surface to support the combined motor rotor and pump impeller."

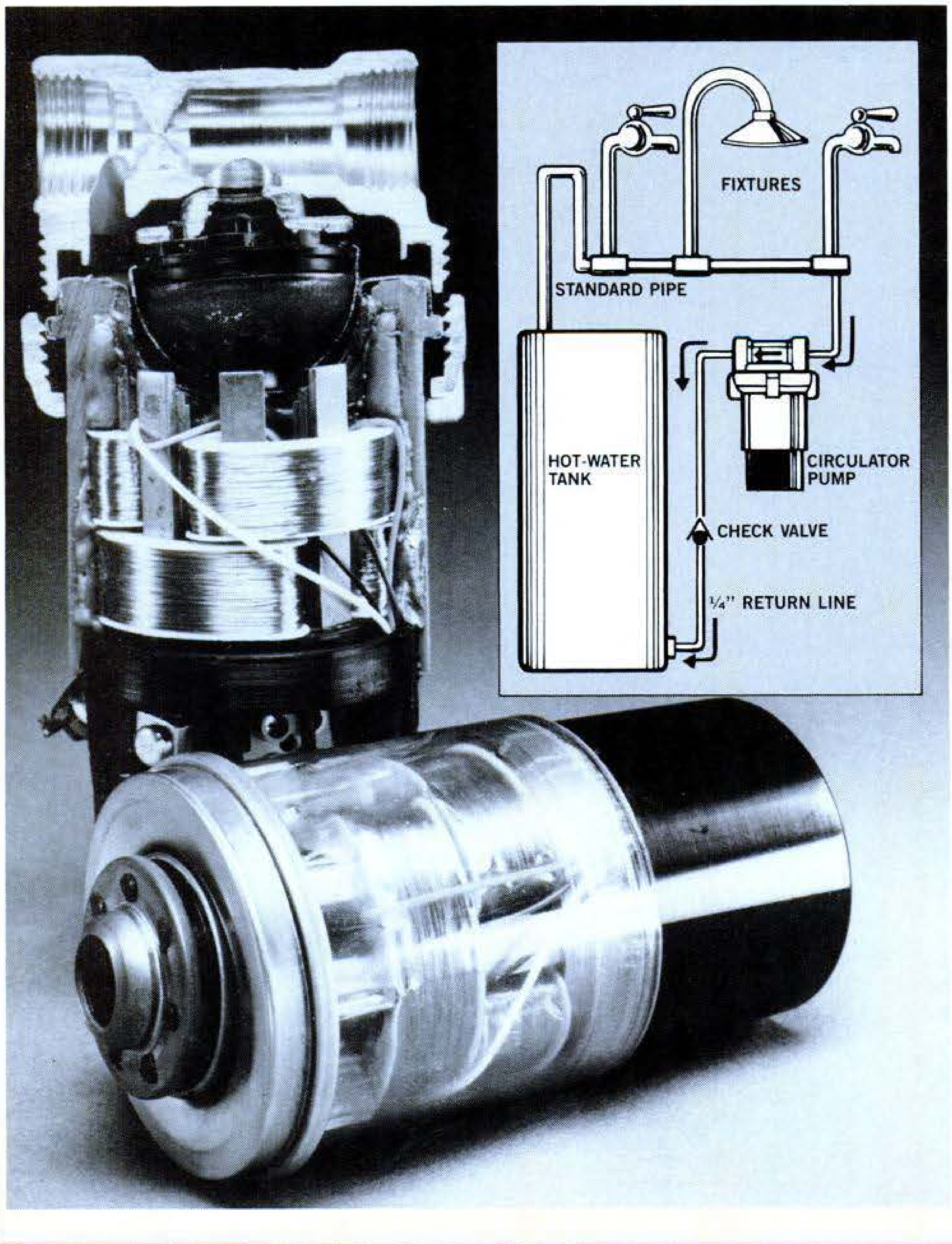
Although Laing circulators are new to this country, more than a million of them are in service in Europe. The pumps are made in a range of sizes suitable for residential solar heating-system circulators, as well as for hot-water recirculators. This last application is a useful home improvement in areas where water is in short supply. You won't save dollars by installing a recirculator, but you will conserve water and gain convenience.

The concept of recirculation is simple: Instead of running gallons of water down the drain waiting for hot water, a trickle of water circulating back to the heater from the farthest tap in the system (see drawing) will keep the water in the pipe hot, so hot water will be instantly available at any tap.

Very little water actually has to be circulated to keep hot water at the faucets—a ¼-in. return line is more than adequate. The lightweight circulator (2.5 lbs.) can be plumbed-in almost anywhere in the system, but for best static pressure it should be located close to the water heater. A check valve should be installed in the return line to prevent back flow of cold water, and the hot-water pipe and return line should be insulated to reduce thermal loss.

The Laing pump doesn't have to be hard-wired, which makes it easier to install. It comes with a 6-ft. three-wire cord that plugs into a standard grounded outlet. The basic model consumes only 25 W of power, but can pump 2.9 gal. per min. (maximum head is 4 ft.). It costs about $100.

Further operating savings can be realized by using a version equipped with an integral timer that can be set to shut off the pump at times when there will be no hot-water use, such as at night. Another model comes with a built-in thermostatic control that aids in reducing calcium buildup, which occurs at temperatures above 130° F. The thermostatic device cuts out the pump when water temperature reaches 130°, and cuts back in when the temperature drops to 110°. This also reduces energy use.—*Thomas H. Jones*



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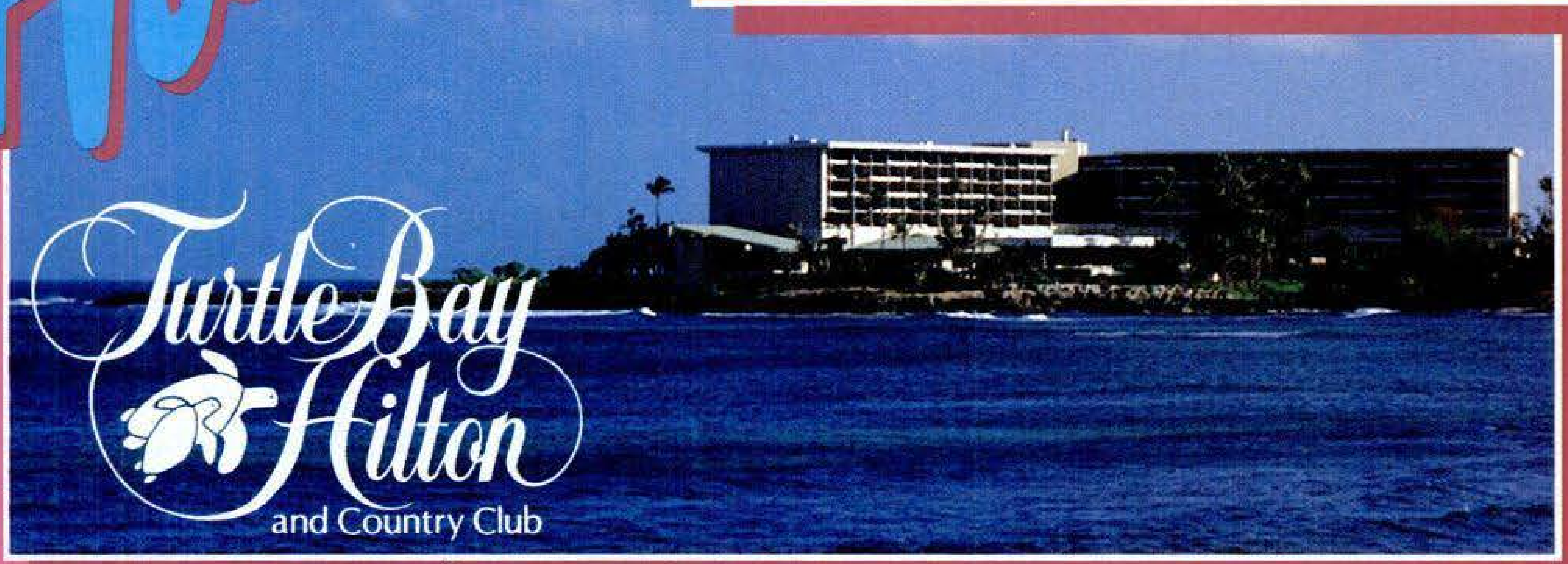

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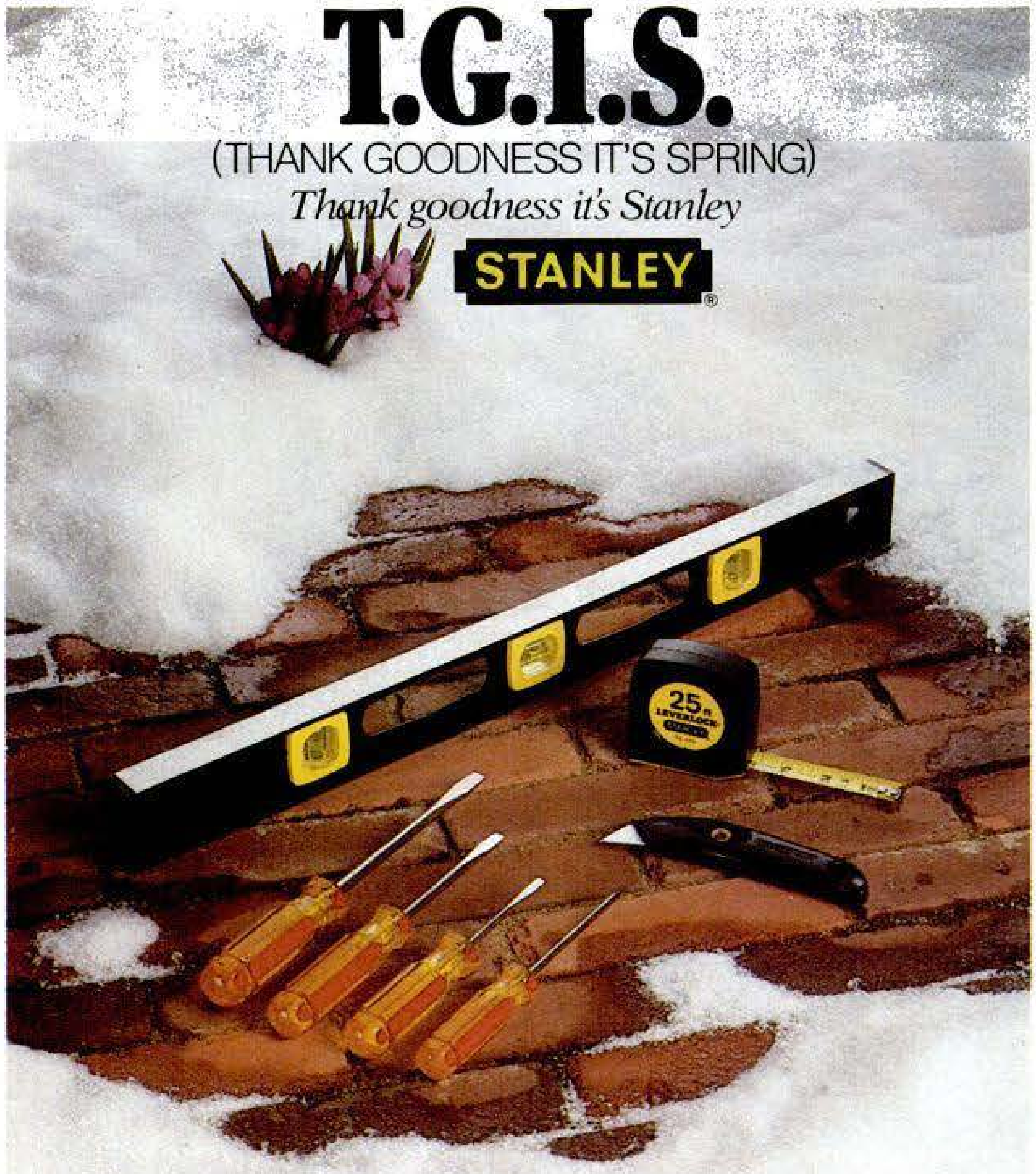
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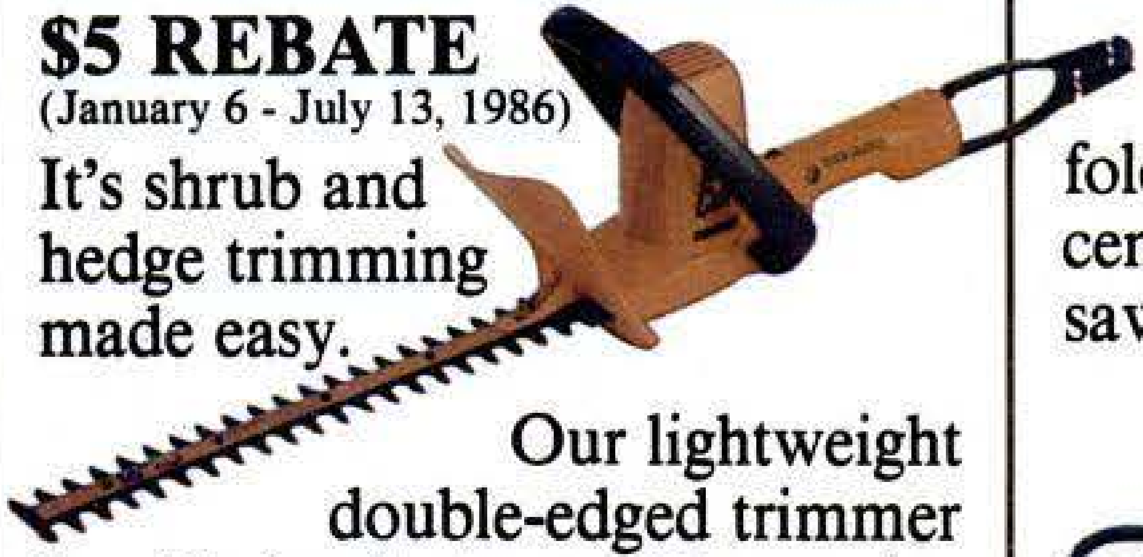

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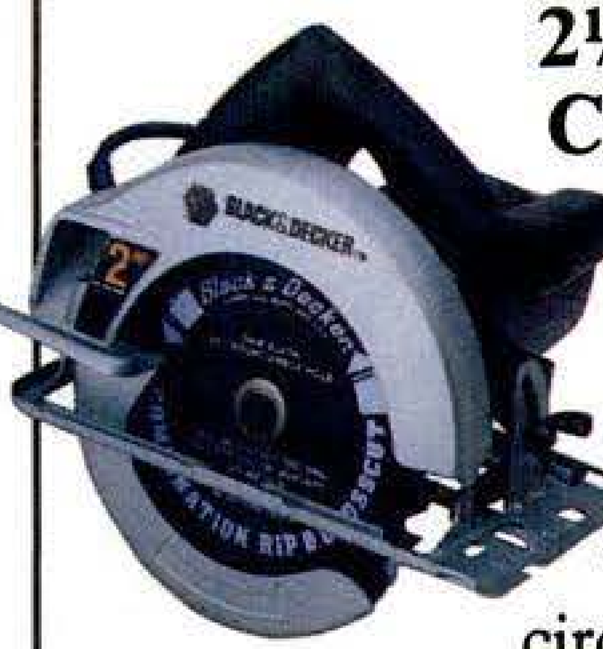

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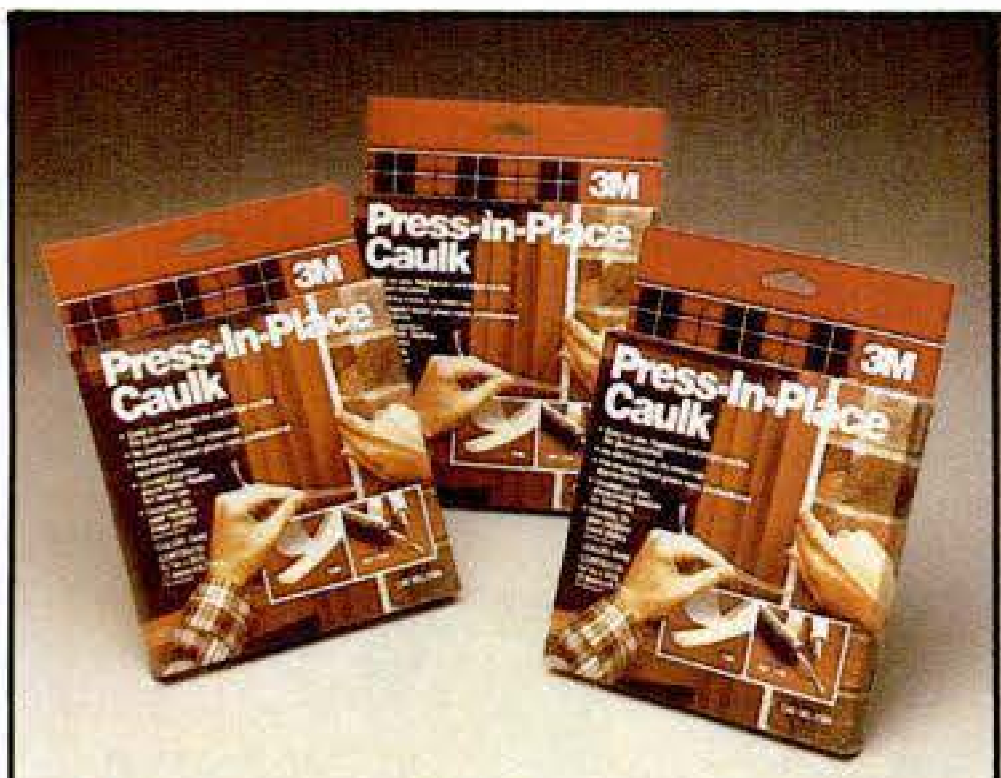
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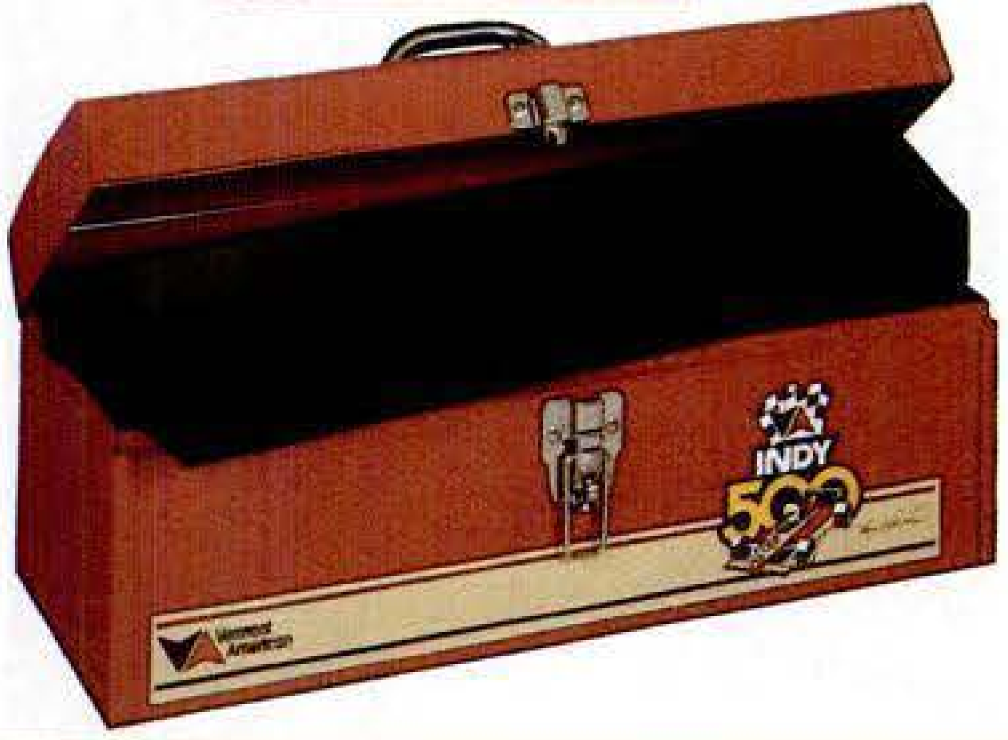

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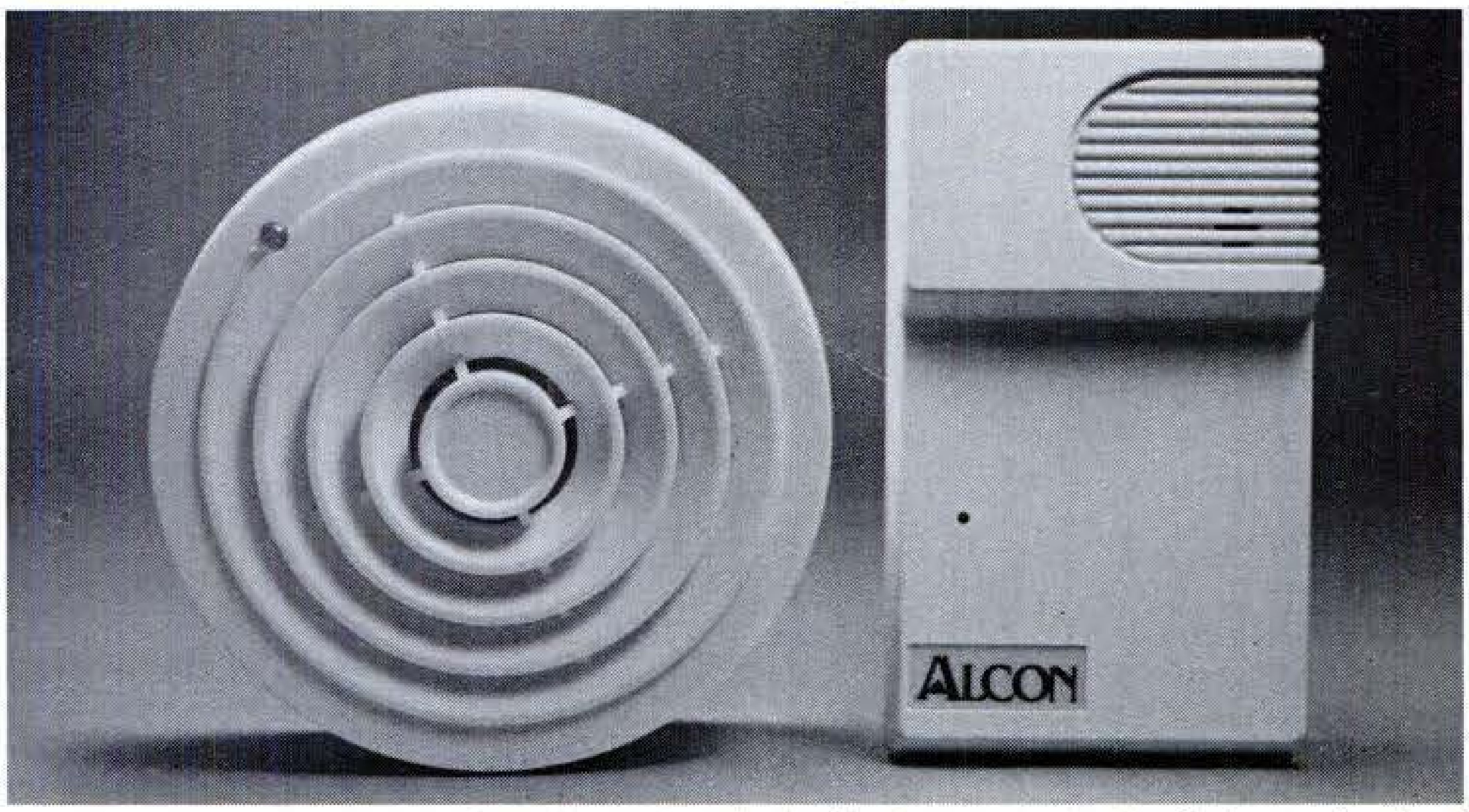
New products for YOUR HOME



Sound protection for homes

Installing an alarm system in your house is a simple but time-consuming task. You've got to attach sensors to each vulnerable door and window, then wire them to the system's central control panel. That's tedious work.

Now there's a new class of sensors that eliminates wiring the eight to 12 individual detectors needed to protect the average-size house. An infrasonic sensor mounts on a wall or ceiling, connects to the control panel, and protects up to 5,000 sq. ft. of enclosed interior space. Infrasonic sensors can also complement ultrasonic or infrared models, which pick up an intruder's presence only after he's inside your house.

I tried two of these new sensors: the round Infra-Switch ($100; from Blue Grass Electronics, 602 W. Jefferson St., LaGrange, Ky. 40031) and the rectangular Infra-X ($120; from Alcon Intl., 57 North St., Danbury, Conn. 06810). Each provided perimeter protection equal to that of the individually wired magnetic switches I had previously installed. In fact, infrasonic sensors were even more sensitive than the manufacturers claimed.

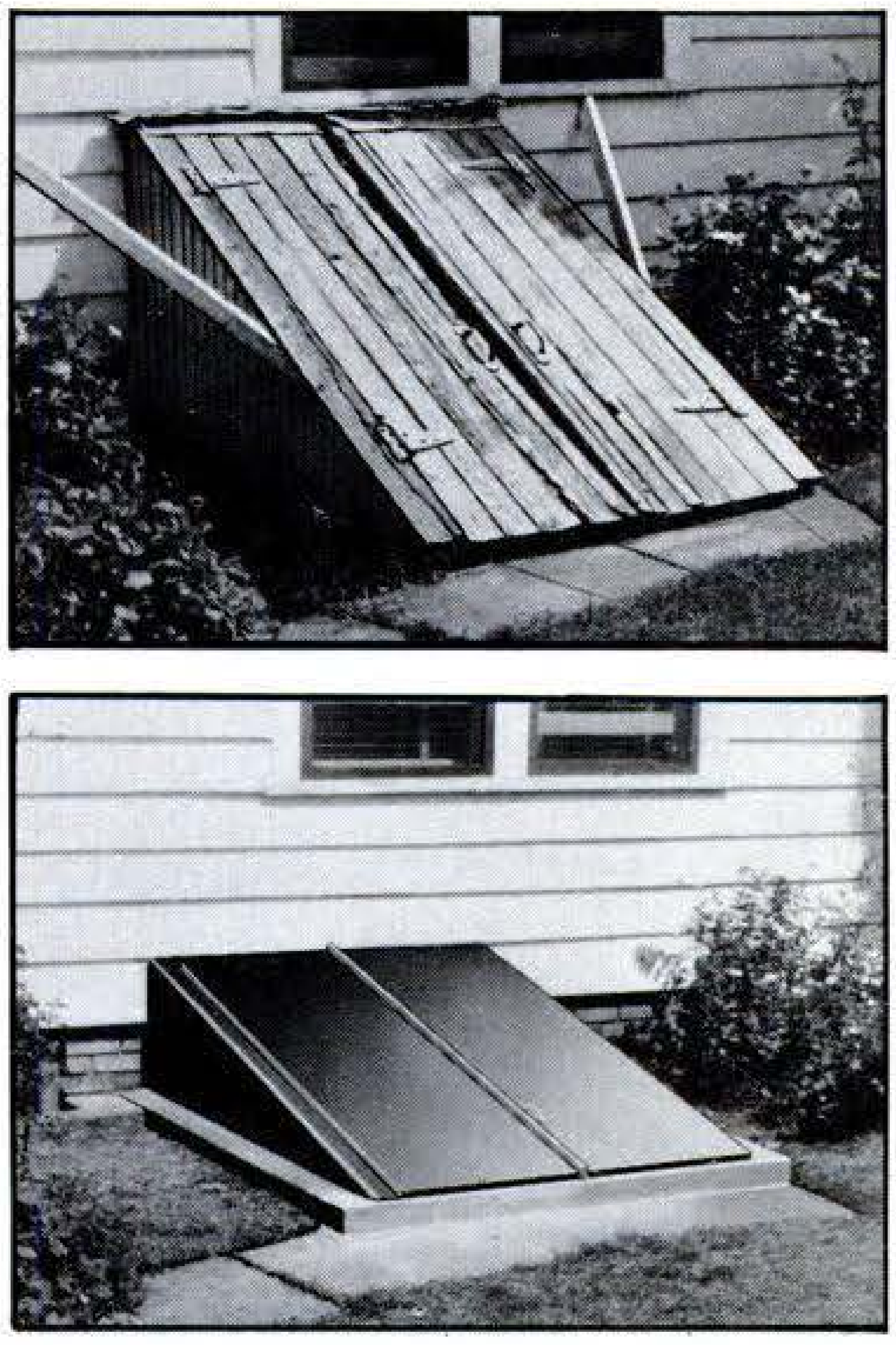
Like ultrasonic sensors, infrasonic models sense sound waves. But the infrasonic frequency range, 0–20 Hz, is below the 20–20,000-Hz frequency range that's audible to humans. That means there's a vast difference in the type of detectable sound—and in the way the sensors protect your house.

Ultrasonic sensors detect movement (as infrared models sense body heat) *within* an area. Infrasonic sensors guard an area's perimeter by detecting minute changes in air pressure between a house's exterior and interior. When a burglar jimmies a door, for example, he causes an abrupt change in the interior air pressure, generating sound waves of about 0.5 to 2 Hz. Infrasonic detectors instantly pick up those waves, which pass through furniture and walls, and trip the alarm.

According to the manufacturers, the low-voltage sensors—Alcon's operates from 7.5-V to 28-V DC, the Blue Grass unit at 12-V DC only—work best with hinged, in-swinging doors and windows. When opened, these doors and windows create a more discernible pressure differential between the exterior and interior than do double-hung windows. Also, the acceleration of the panel's surface as it moves inward compresses the air in front of the panel, which also generates sound waves that can alert an infrasonic sensor.

I found, however, that opening any door or window—regardless of the direction it swings—was enough to trigger either sensor. Although I installed both the Alcon and Blue Grass units at one end of the first floor of my 1,800-sq.-ft. house, they each detected door openings at the opposite end. The Blue Grass unit even sensed the opening of a hallway door *upstairs*, giving me several tension-filled moments one night until I uncovered the cause.—*David Petraglia*

Appearance
Performance
Durability



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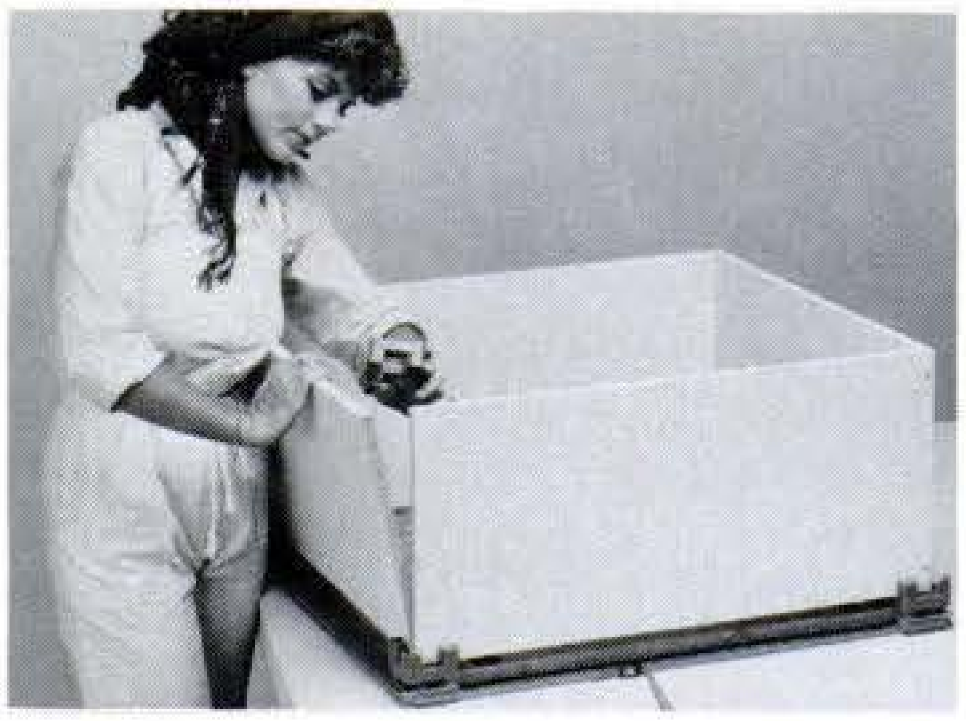
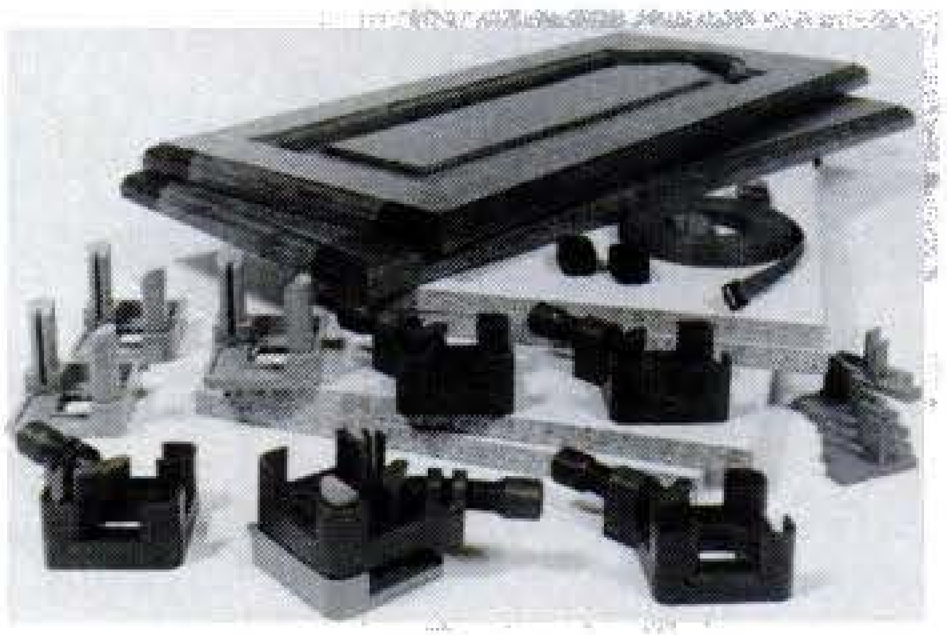
New products for YOUR HOME





Cabinet clamp kit

A handy plastic jig system from Britain makes it easy to build fitted kitchen cupboards, storage cabinets, shelves, drawers, and bedroom furniture at home. The Cabinet Mate kit (marketed by Pentabridge Ltd., 53 Newnham Rd., Cambridge CB3 9EY, England) consists of door and universal clamps, a webbing belt, door and overlap spacers, and positioning guides (above).

To start construction, place the door(s) facedown to serve as a base and fit the door clamps to each corner. Then bind the assembly together with the belt. At this point, slip the universal clamps onto the door-clamp posts, and position the precut side panels (not provided) by tightening the bolts.

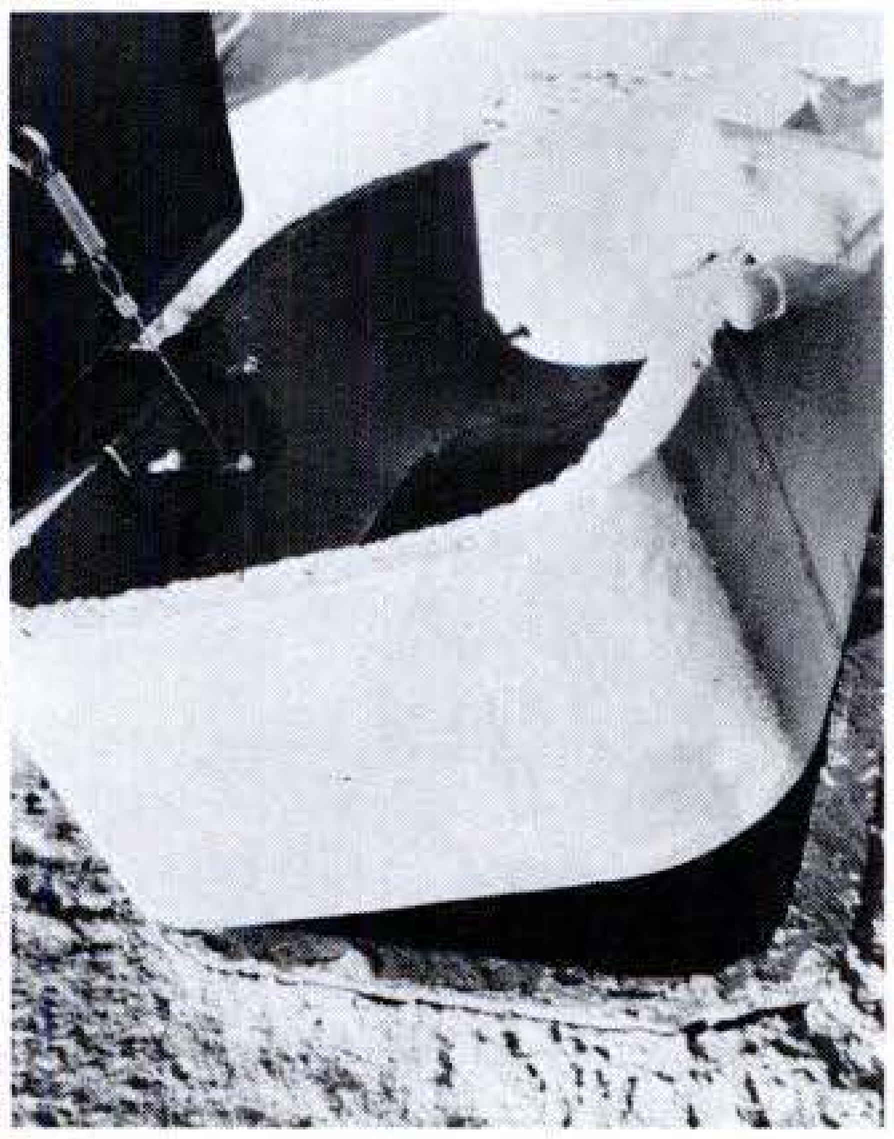
The top and bottom panels can now be cut to size and clamped to the base (top photo). Now fix the universal clamps to the top corners, and drill the screw holes. After the panels are fastened together, remove the clamps and position the door(s) with spacers. Finally, drill screw holes for the hinges and attach the door(s).

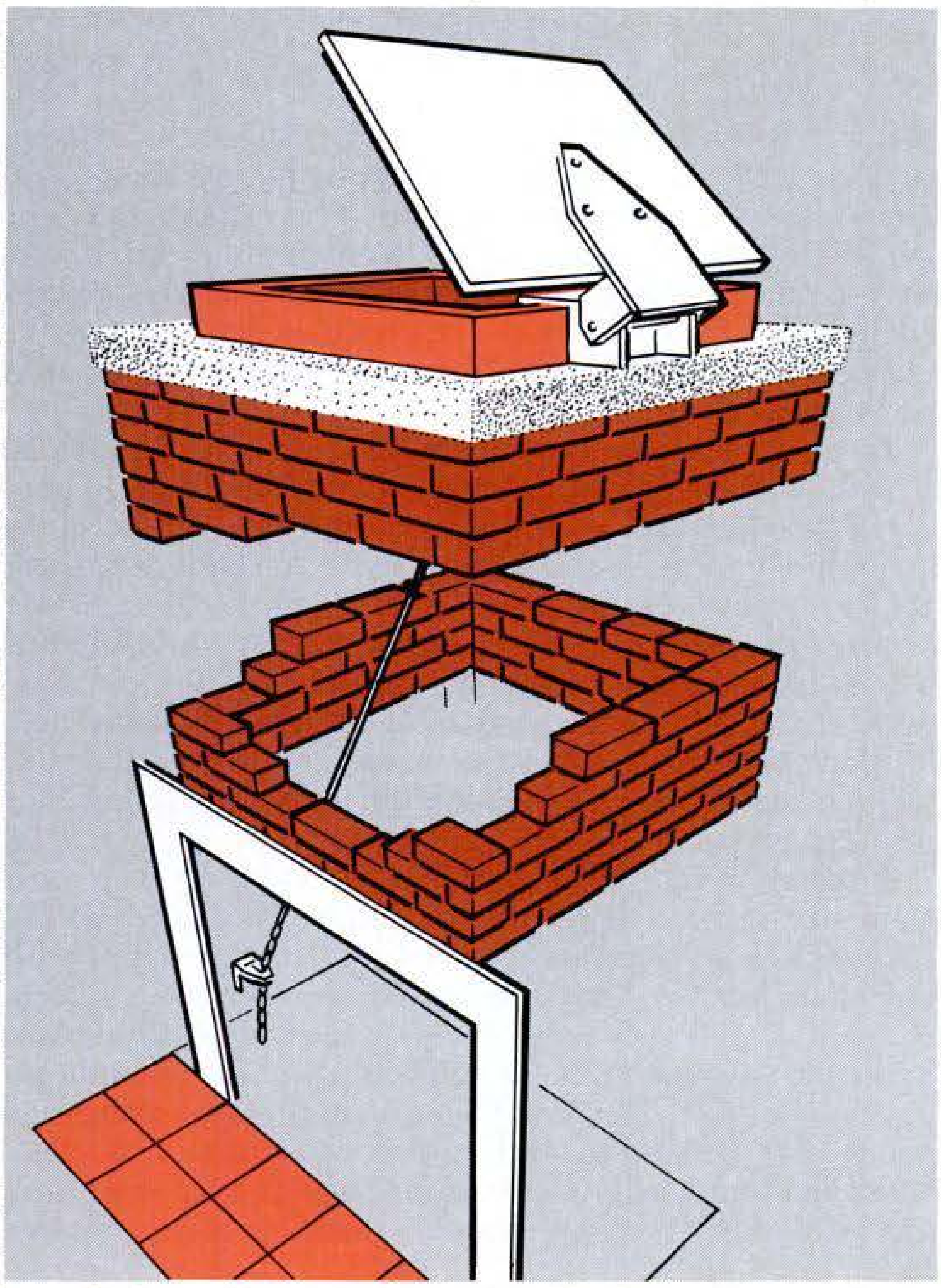
Cabinet Mate comes with a fully detailed booklet of step-by-step assembly instructions.—*David Scott*

New products for YOUR HOME

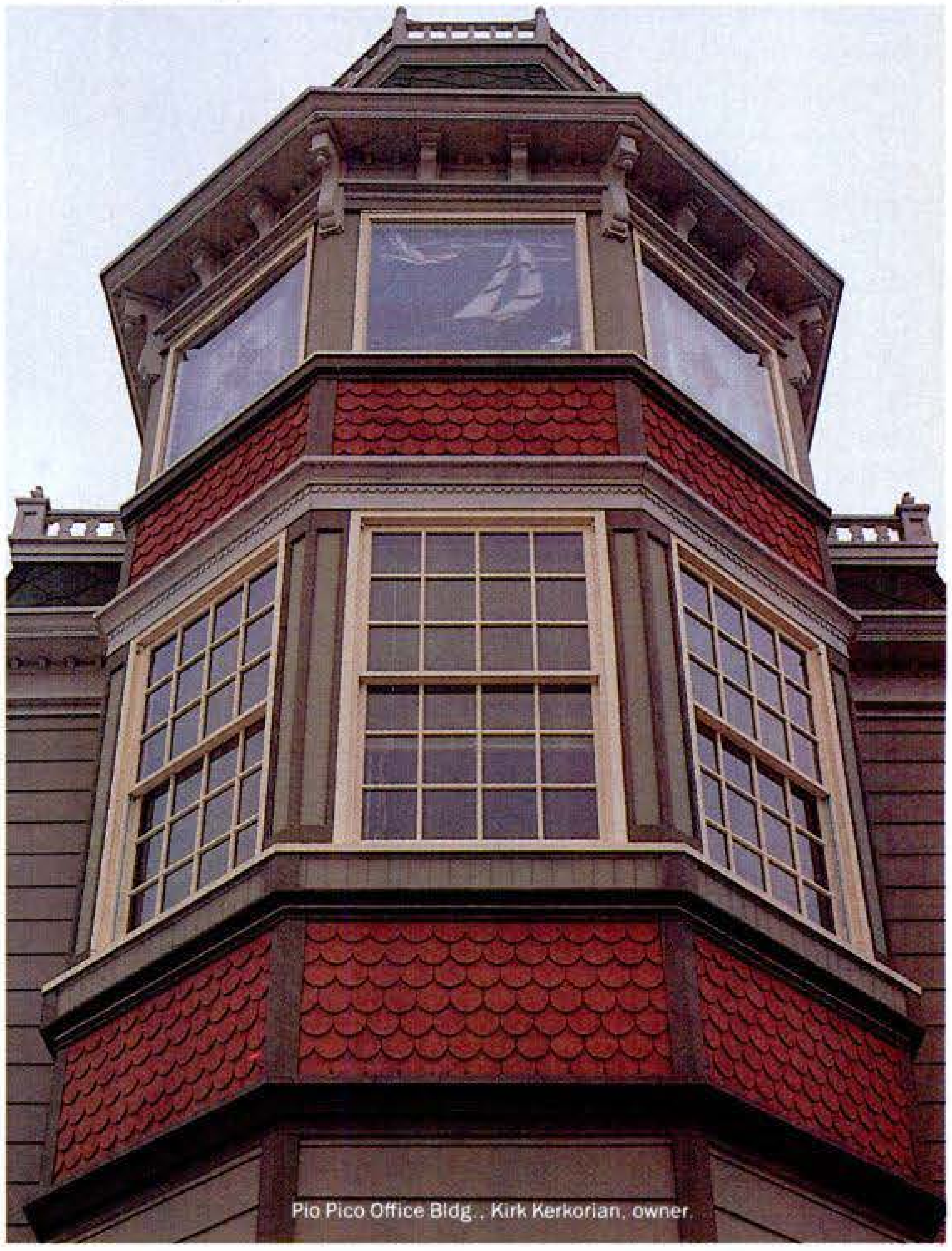
Draft-beating chimney cover

Put a tight cap on the chimney when the fireplace isn't being used, and you won't lose any heat or cooling you've paid for. Also, you will prevent rain, drafts, and little creatures from entering the house, say the makers of the Seasonal Control Cover (AFMO Inc., Box 62-C, Moberly, Mo. 65270). This spring-loaded door assembly clamps onto the chimney flue tile. If your chimney doesn't have a minimum 3 in. of exposed tile, an additional tile must be added before installation (photo at left). A chain at the fireplace opening controls the door. The price is $55.45 with shipping.





THOSE WHO CHERISH AUTHENTICITY TEND TO LOOK DOWN ON ANYTHING LESS.



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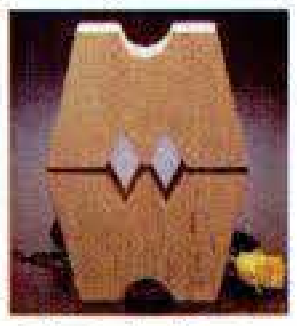

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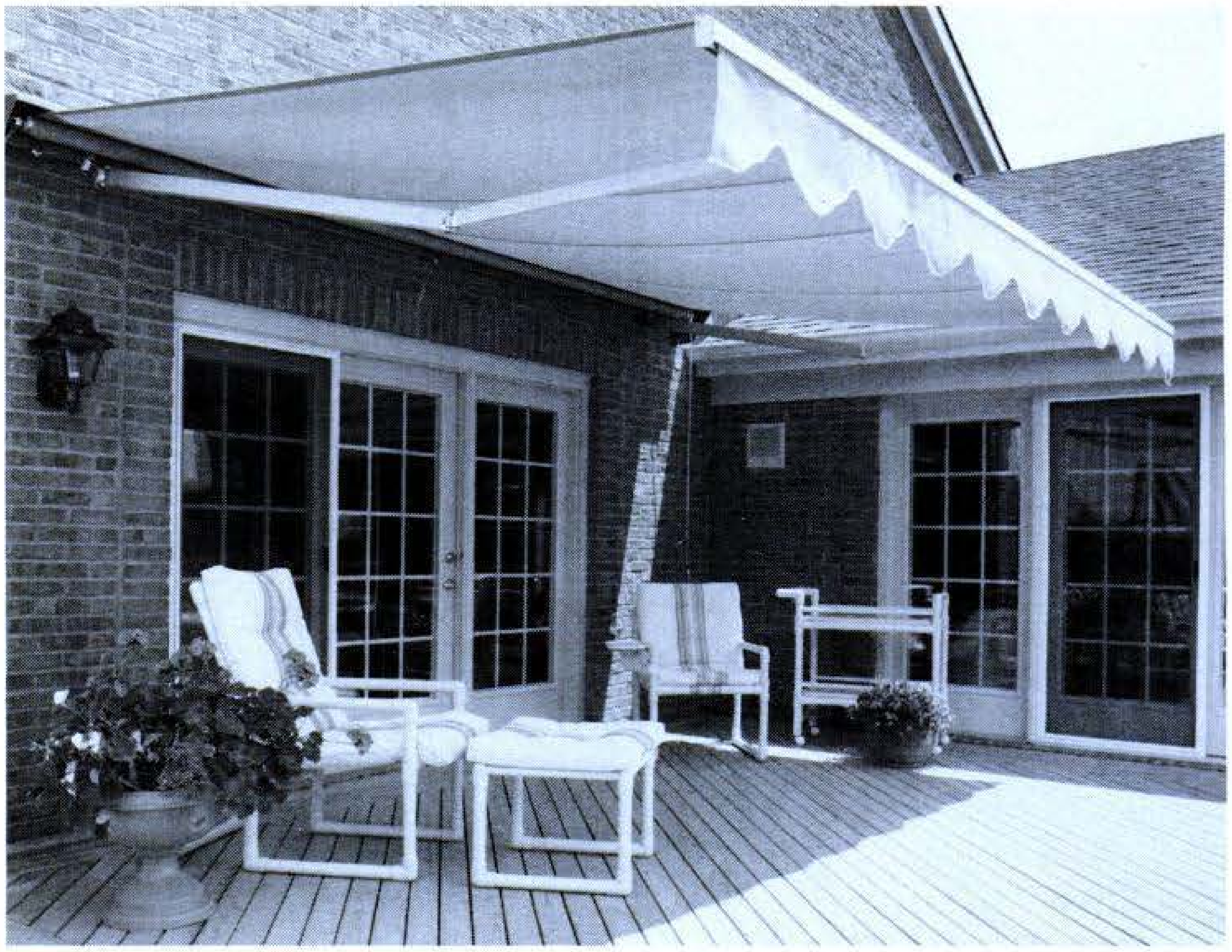
New products for YOUR HOME

Retractable patio awning



Hot sun or light rain can drive you off your patio and send you scurrying inside. An awning would provide protection—but at the expense of blocking the sun when you want it to shine in. And an awning can be damaged by wind or hail. Besides, the overhang's an eyesore—right?

Wrong. Now there's the Arbor Retractable Patio Awning, from Pease Industries (7100 Dixie Hwy., Fairfield, Ohio 45014). This acrylic awning is available in four bright colors and retracts on a reel that's bracket-mounted to the house. Installation takes an afternoon, it's claimed.

A hand crank (or optional electric motor) connected to hinged mechanical arms controls the awning. Turn the crank one way, and the supporting arms swing in, letting you roll back the awning for sunbathing or to protect it from the elements. Turn the crank the other way, and the arms straighten out, unfurling the awning to provide shade or cover during a summer shower.

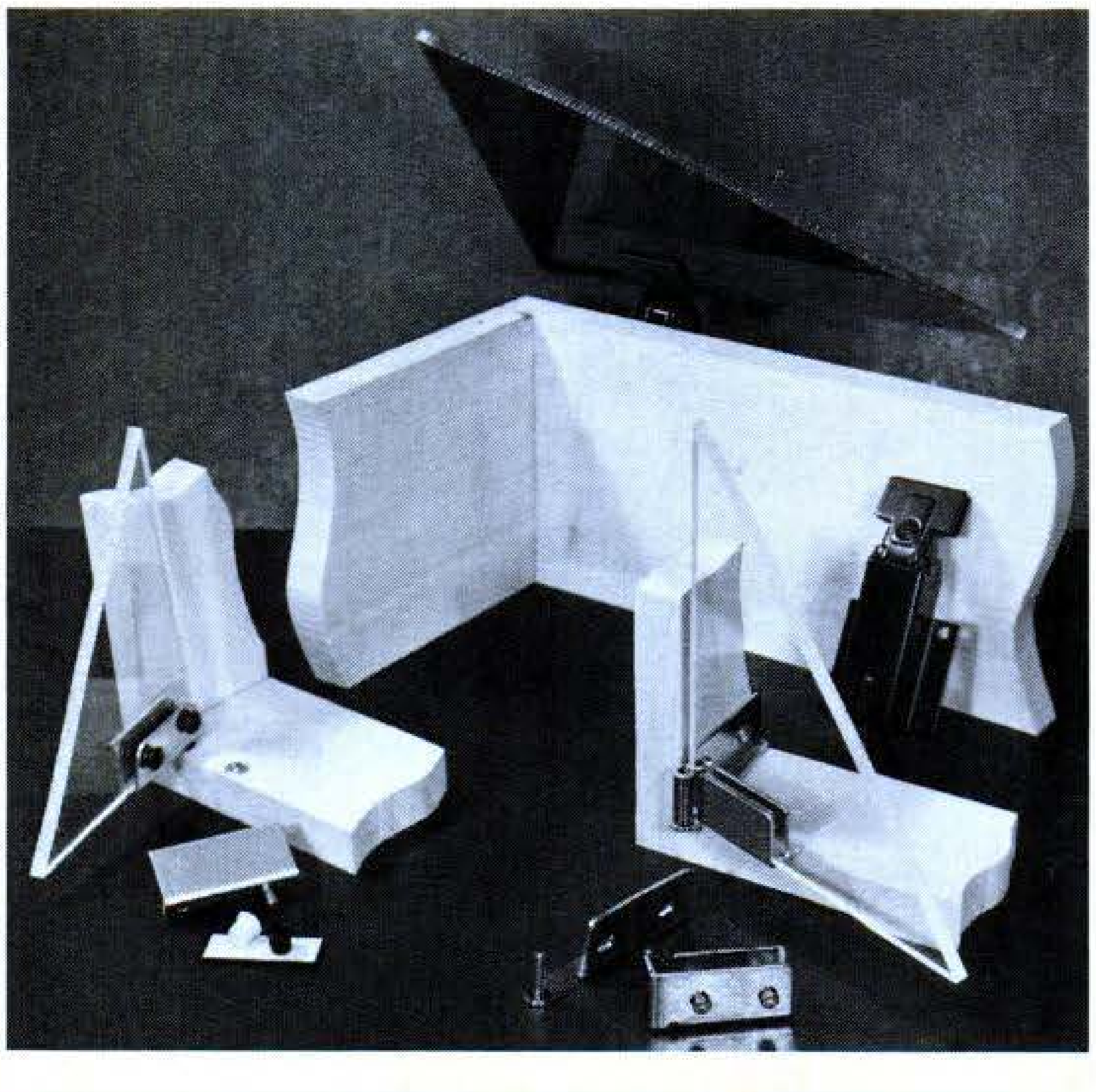
The awning comes in two sizes: 10 ft. wide with an 8-ft. extension, which lists for $795, and 14 ft. wide with a 10-ft. extension, for $945.

If you can't snug the awning under your house's eaves, there's an optional aluminum hood that protects it from nesting birds and moisture. The hood also provides protection for the self-storing awning during the winter. —*Richard Layne*

No-drill hinges for glass doors

Perhaps it's an indication of our unending curiosity—we always want to know whether a lady or a tiger awaits us—but glass doors on cabinets seem to be enjoying a comeback.

See-through doors can serve a number of purposes: to show off a silver collection in the living room, for example, or to provide a break in a monotonous march of wooden kitchen cabinets. In the past, installing hinges meant that a do-it-yourselfer had to sink holes in the glass—a tricky job at best. But now there's an assortment of attractive, easy-to-mount hinges—and complementary magnetic pulls, strikes, and handles—that don't require drilling into the glass. Any of these sturdy hinges will make a handsome addition to a cabinet.



These hinges usually accommodate $^3/_{16}$- and $^1/_4$-in.-thick plastic or glass, gripping it by its edge in a metal channel. The adjustable spring-loaded lid (rear), for example, holds the glass in cushion-faced jaws. To clamp the glass, the hinges use special screws that are either nonmetallic or are protected by bushings so they won't crack the glass when they're tightened. Matching handles, pulls, and magnetic strikes slip over the edge of the glass and are held in place by similar screws or pads. The hinges can also include some nice features, like a ball detent to hold the door closed.

If you're planning to install glass doors on your next cabinetry project, here are some tips. You can find the hinges in most woodworkers'-supply catalogs if you can't buy them locally. After finishing all wood surfaces, measure the door dimensions. Keep in mind that the hinges will take up space in the door opening. I recommend that you have a professional do the necessary glass cutting and machining. Be sure to tell him that you're installing glass doors and that you'd like the edges to be at least smoothed, and preferably rounded and polished, for a professional look.—*Phil McCafferty*

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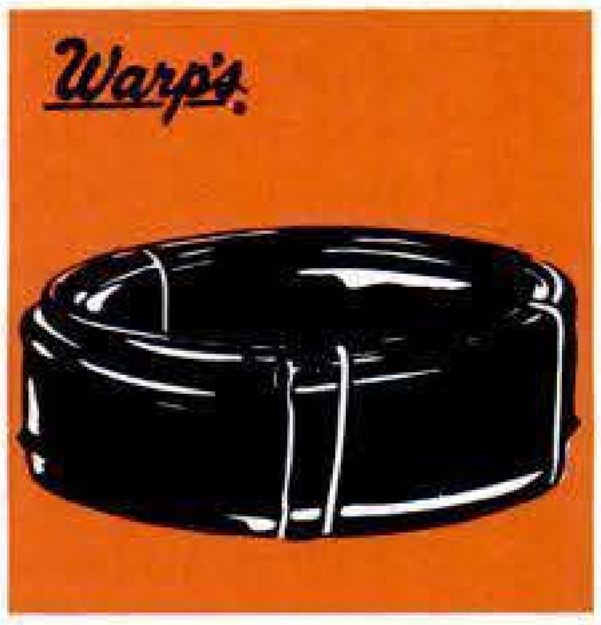

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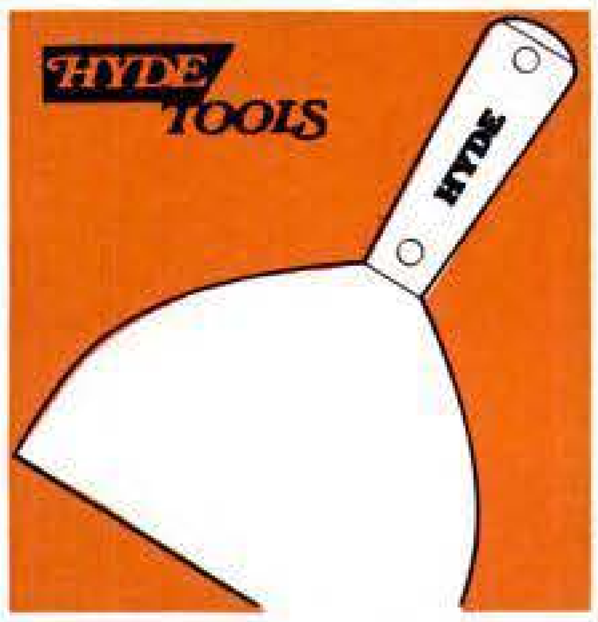
$5.97

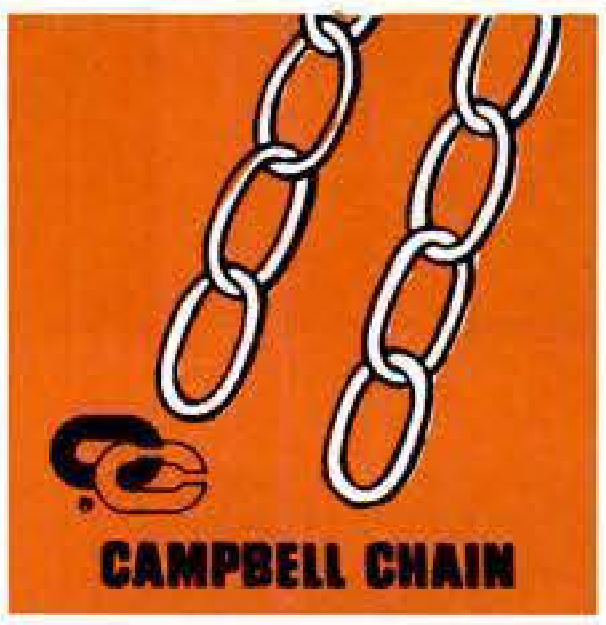
5″ x 20′ black. Retains gravel chips and growth of grass. (LB520B)


HYDE TOOLS
HYDE

6″ JOINT KNIFE

$3.79

Flexible blade helps make professional looking finish to joints. (02850)


CAMPBELL CHAIN

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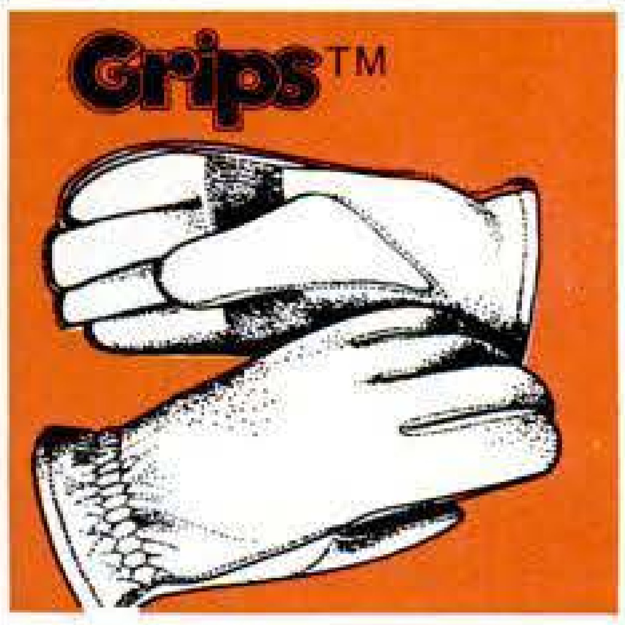
59¢ per foot

For hanging plants, etc. in bright or antique brass, black. (072-0867/0897/0967)



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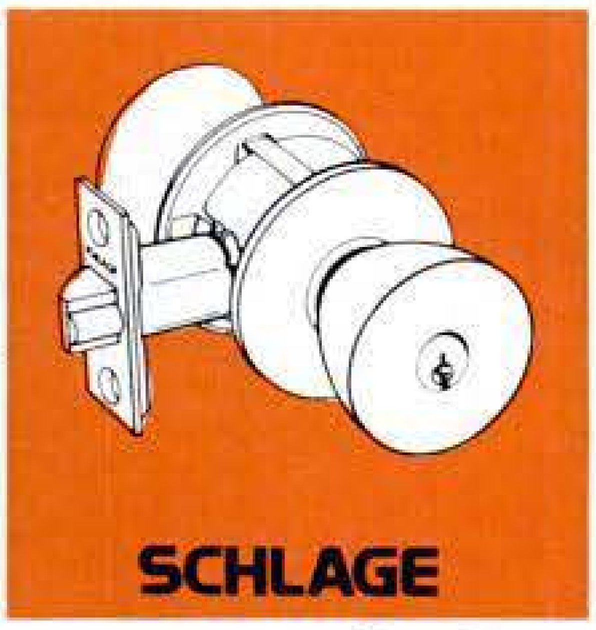

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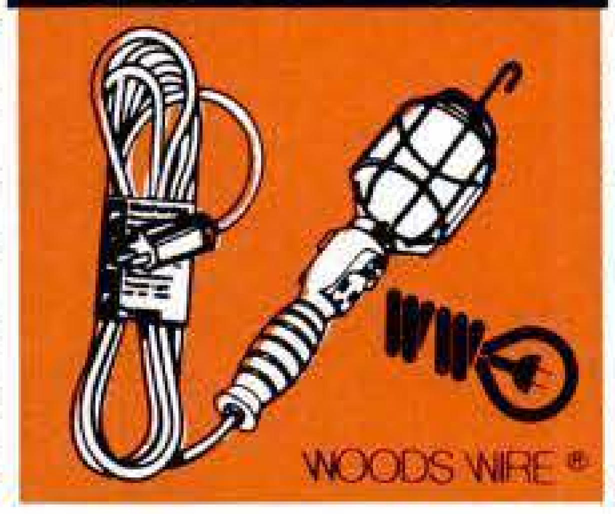

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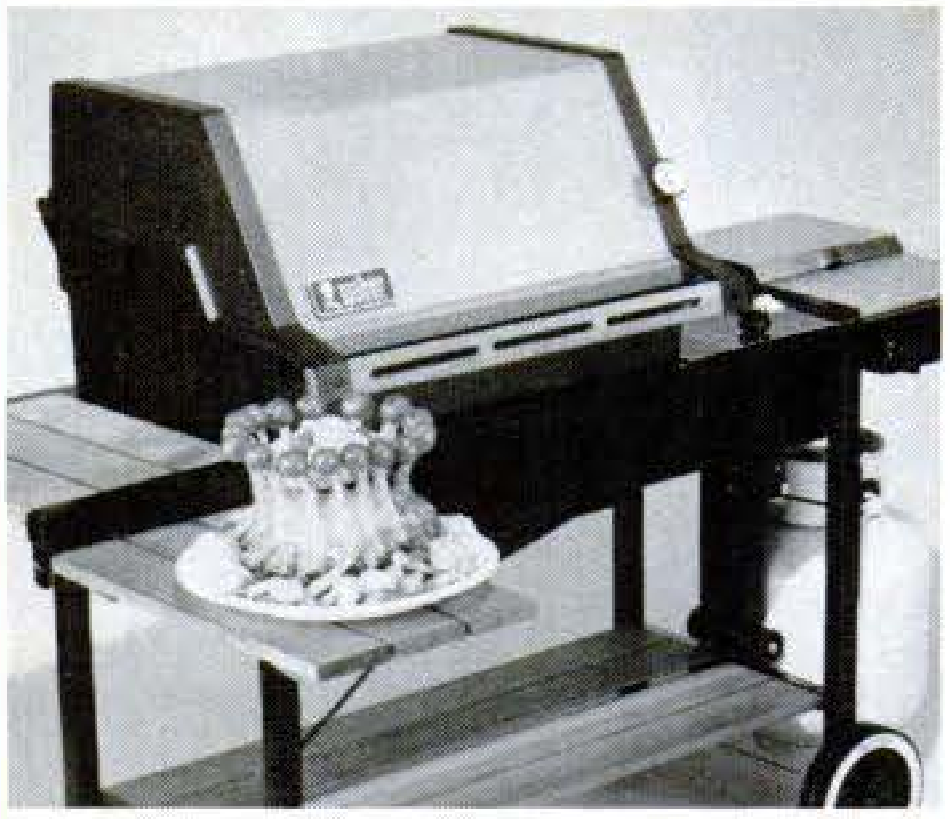


Barred barbecue

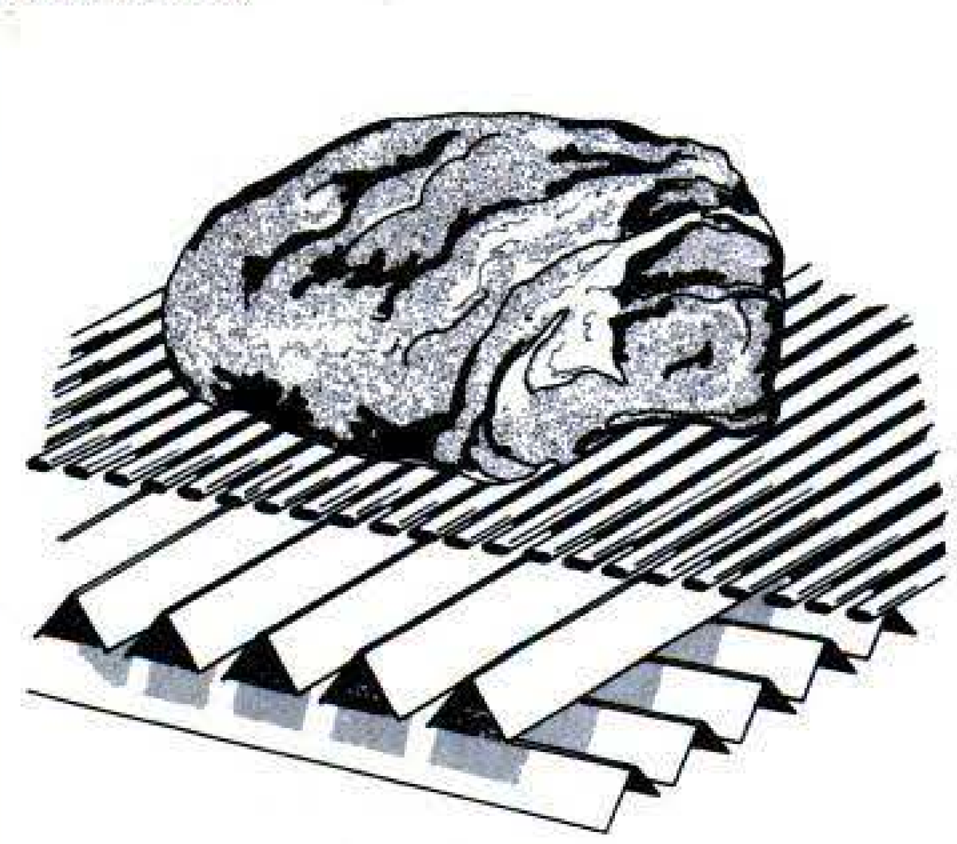
That beloved flavor of meat cooked on a barbecue grill comes mostly from the smoke that's created when the meat juices land on red-hot charcoal, or, in gas and electric grills, on hot lava rocks or pumice stones. But fats in those juices often give you flare-ups as well as flavoring.

Now Weber-Stephen Products Co. (200 E. Daniels Rd., Palatine, Ill. 60067) has replaced the rocks with a two-layer grid of pyramidal bars (drawing below). These Flavorizer Bars, says Weber, give the smoke of lava rocks, but not the fire.

Each porcelainized-steel bar forms a 52° angle, which lets fats linger long enough to vaporize but not long enough to flame, Weber claims. Instead, they fall into a catch pan (with disposable liners). For easy cleanup you can remove the bars (top right photo) and pop them—and the cooking grills—into your dishwasher.

Flavorizer Bars are featured in Weber's Genesis gas (natural and LP) grills. All have three stainless-steel burners (maximum heat output: 36,000 Btu/h) that light with a single button. In the LP-gas models, the tank hangs from a scale; you can determine the fuel level from the weight of the tank. Natural-gas versions have 12-ft. hoses.

The $549 Genesis III (top at left) has a range-top-style gas burner for warming sauces or coffee. The Genesis II ($479) has the same cedar work surfaces and bottom storage rack as the III, but has a cedar shelf in place of the spare burner. The Genesis I ($399) has a small cedar shelf on the left and a wire bottom rack. All three models come in red, black, or chocolate.



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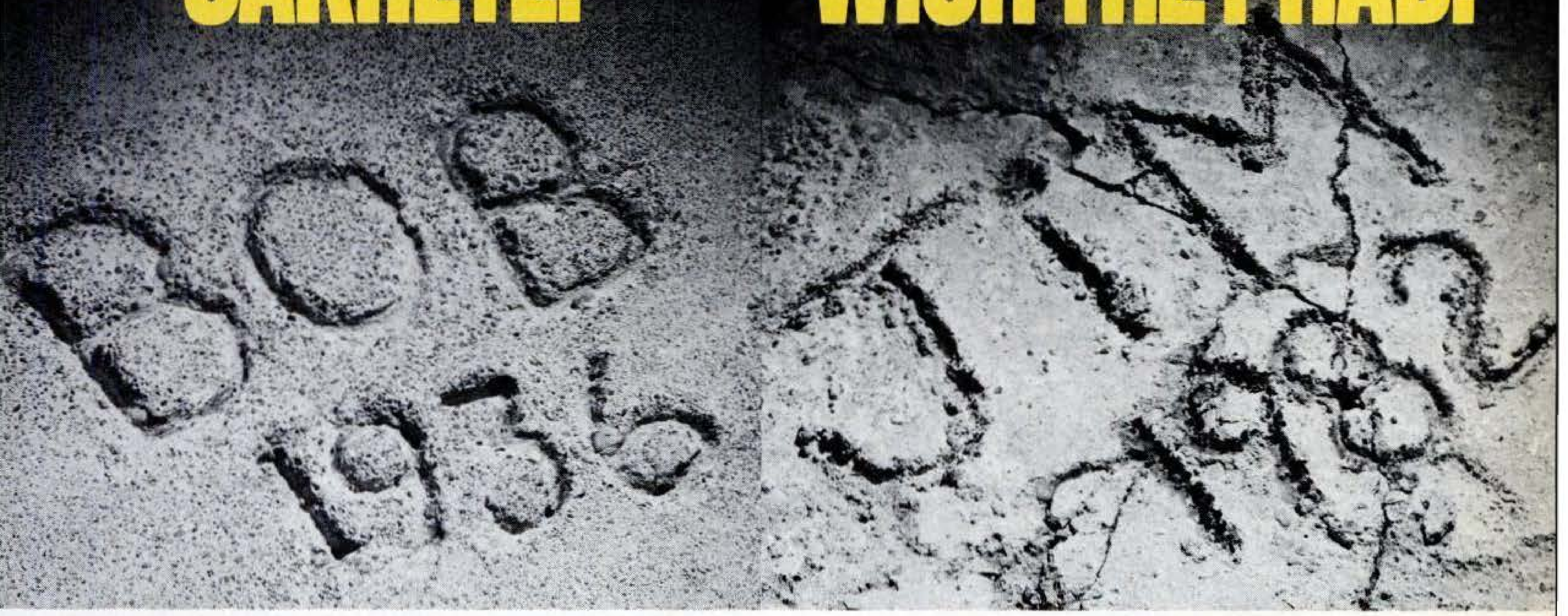

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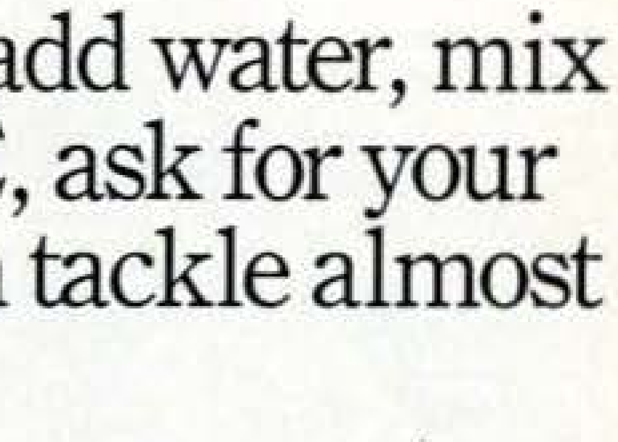

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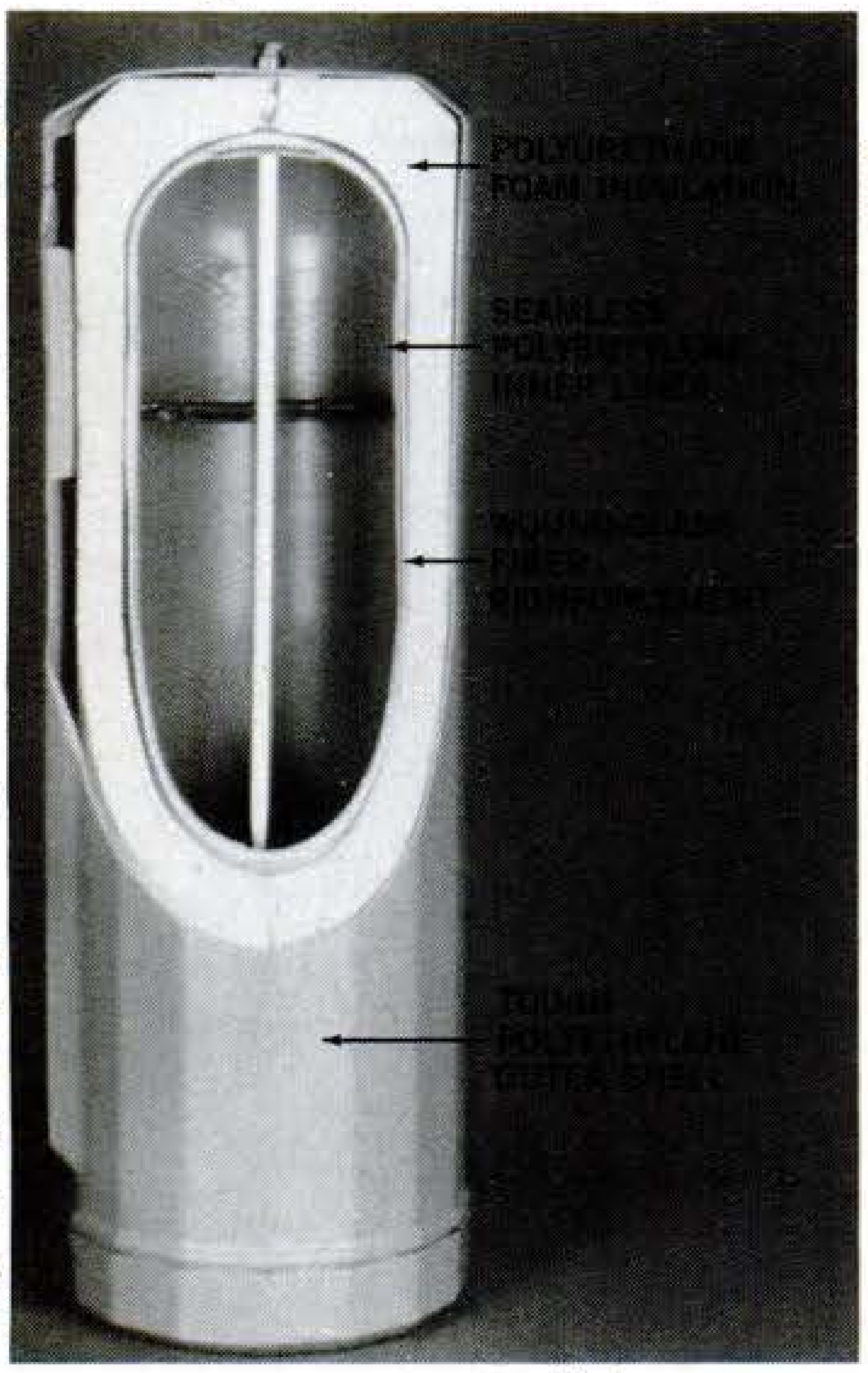
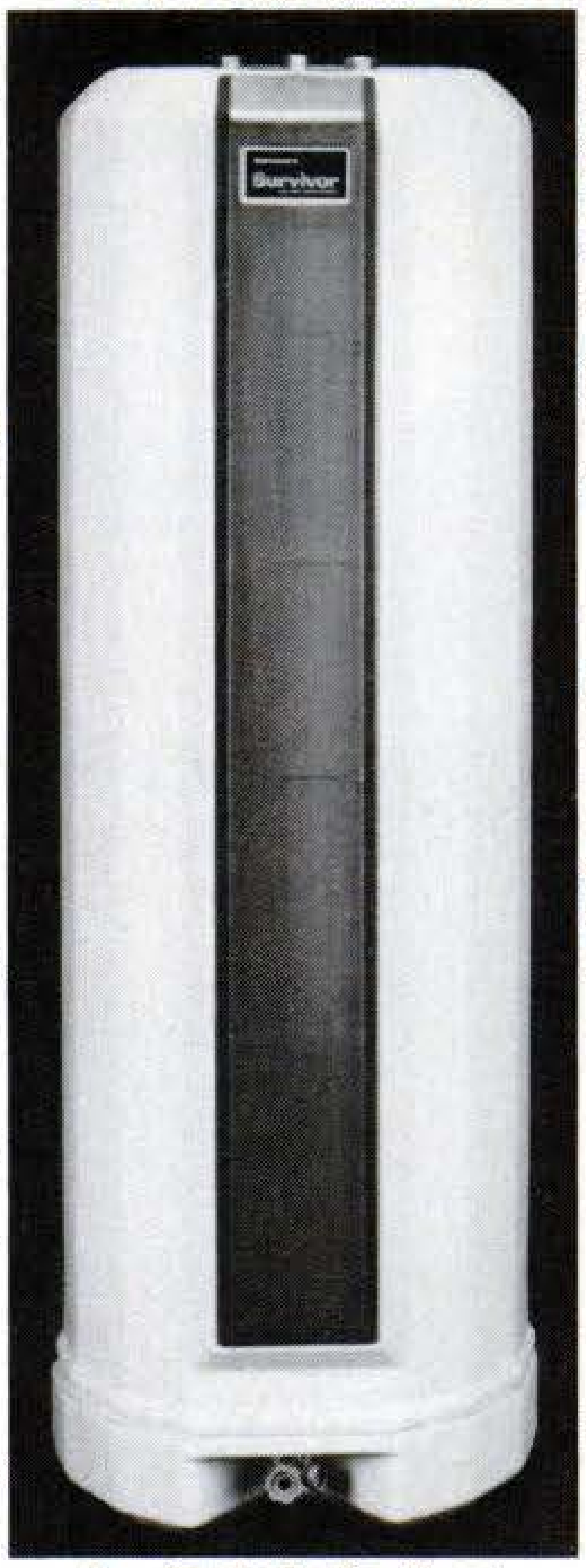
New products for
YOUR HOME


POLYURETHANE FOAM INSULATION
SEAMLESS POLYETHYLENE INNER LINER
WOUND GLASS FIBER REINFORCEMENT
TOUGH POLYETHYLENE OUTER SHELL



Plastic water heater—guaranteed not to leak

A spreading puddle of water is often the first sign that there's a leak in your electric water heater. Despite a glass liner, electrolysis can chew holes in a conventional steel tank in as little as five years. "Roughly forty-five percent of the home water heaters sold in the U.S. are replacements for leaky tanks," says Don Forney, Sears, Roebuck and Co.'s national buyer for water heaters. "So we decided to see if we could find a good alternative to repeatedly replacing leaky steel units."

The alternative is the Kenmore Survivor, a nonmetallic electric water heater with a guaranteed leakproof plastic tank. Sears will replace the water heater free of charge (excluding installation costs) if the tank fails while the original buyer owns the house in which the unit is installed. The lightweight, energy-efficient Survivor also has dual heating elements for normal and peak-period hot-water output, simplified electrical wiring hookups, and a meltdown prevention sensor, Forney says.

Sears offers the $349-to-$399 Kenmore Survivor water heater in three sizes (30, 40, and 52 gal.) and two output rates (17.2 and 25 gal./hr.).
—*Steven Ashley*

You can clean up the mess burglars leave. But you can't clean up the awful memories.

Do you have any idea what it's like after burglars have been in your home?

Most people feel dirty. Violated.

Some people never quite get over it. Many eventually move. Almost all burglary victims immediately put new locks on their doors—*after* it's over...when it's too late!

The most important lock is a security deadlock. Many law-enforcement experts agree that a good, heavy-duty deadlock with a one-inch deadbolt is probably the single most effective way you can keep your home and family safe from intruders.

Kwikset's 880 Series deadlocks are the most secure locks we've ever made. And as manufacturers of America's largest selling residential locksets, that's a big statement.

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Get maximum protection against burglary!
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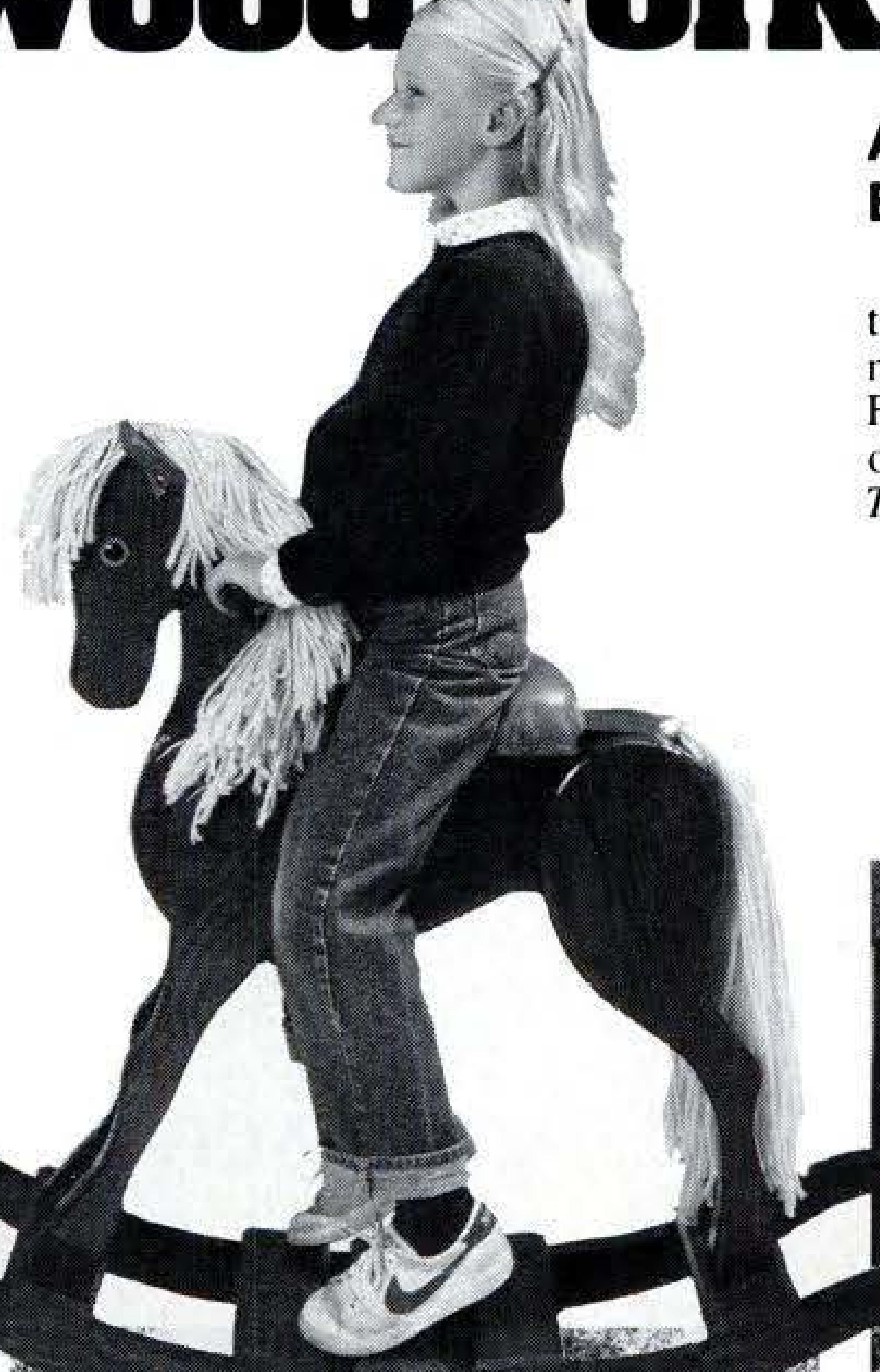
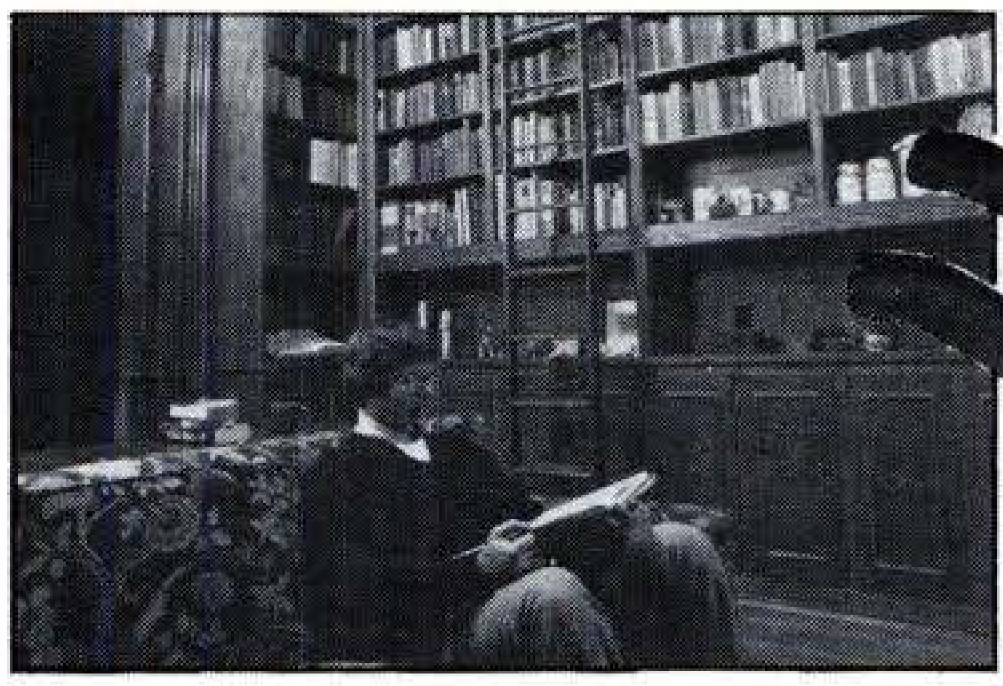
Get down to fundamentals... Experience the joys of woodworking



Are you missing out on the joys of woodworking? Imagine for a moment the shine in your little girl's eyes the first time she sees the rocking horse you built just for her. Or think of the fun you'd have on a deck added to your house — built with your own hands. Maybe the cooks in your family would like a kitchen custom-made to their needs. Or consider how much enjoyment you'd get from your stereo system if you built your own entertainment center.

Unlike many other hobbies, woodworking is a hobby of the imagination as well as the hands. Starting with nothing more than an idea, you create things that express your individuality, creativity and common sense. You solve problems, learn new skills — and save money in the process. But most of all, woodworking is fun.



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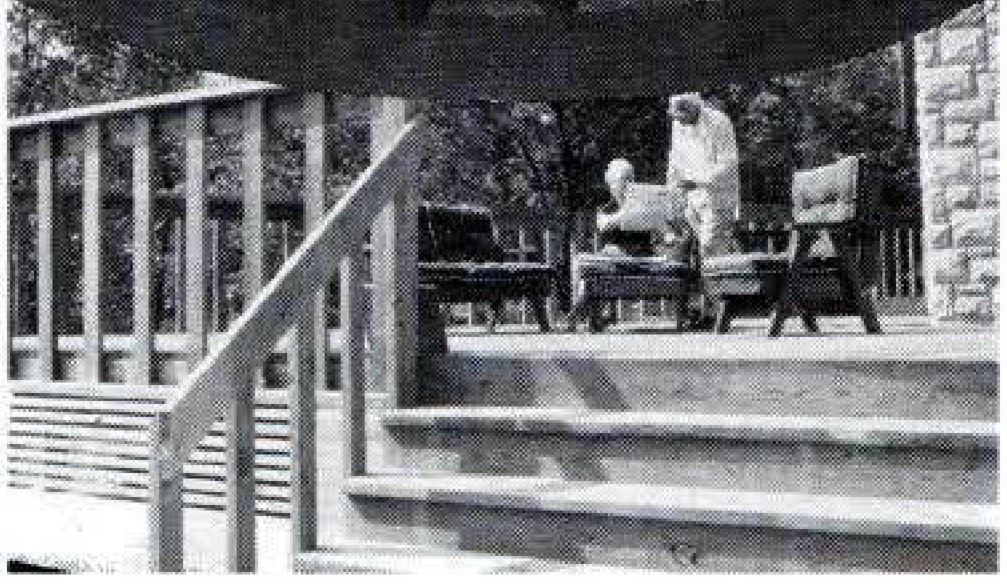

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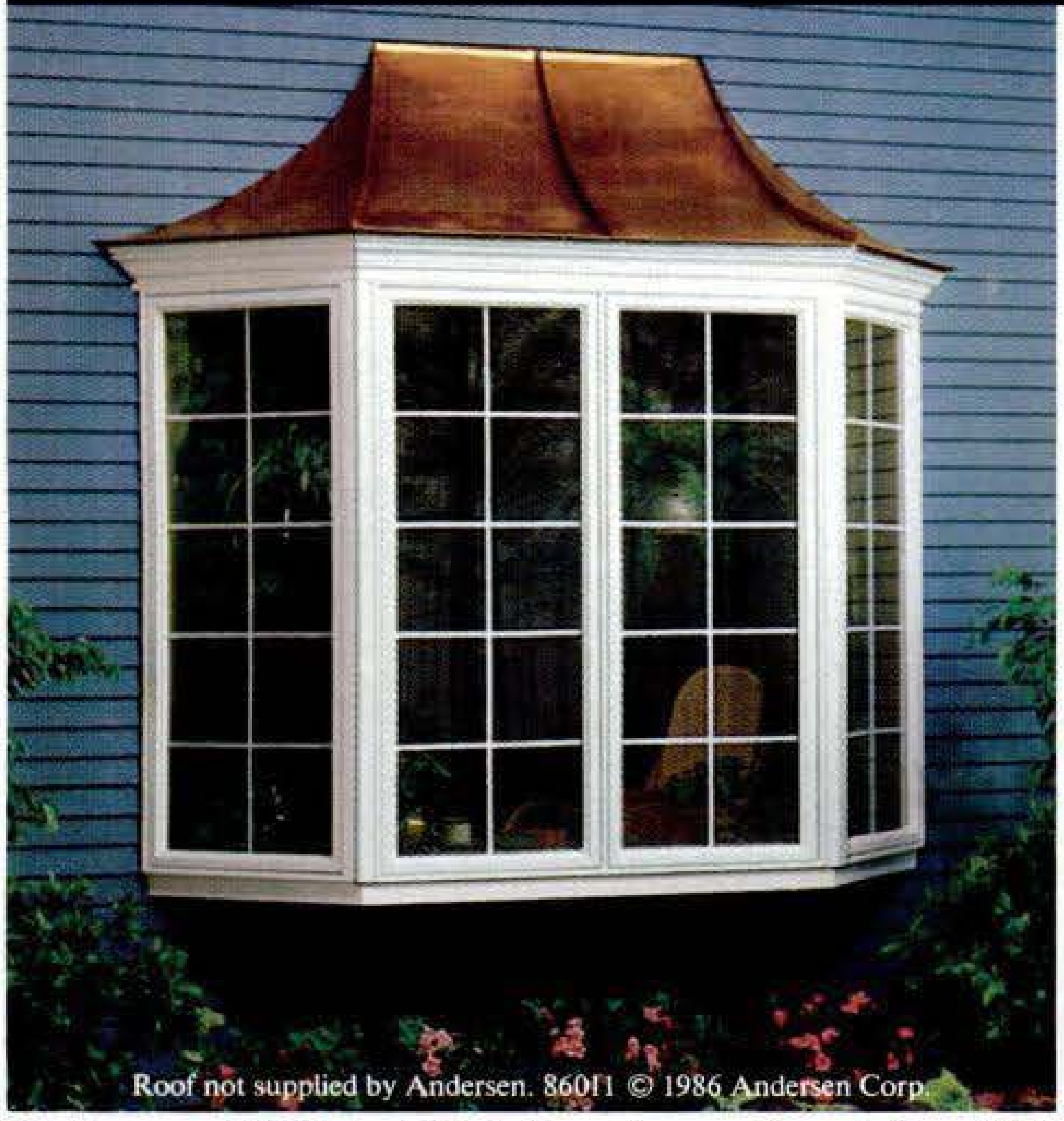

If new windows are part of your remodeling, or if you're replacing problem windows, the Window Beauty people have just the book for you. It is called "Window & Patio Door Answers From Andersen" and it's packed full of facts, figures, window planning ideas–everything you need to ensure window beauty, quality, low maintenance and energy efficiency. Send for your free copy. Do it today!

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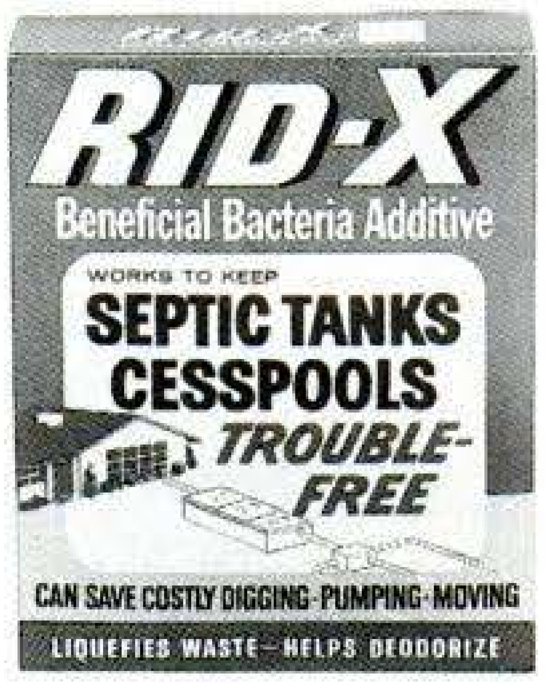
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CAN SAVE COSTLY DIGGING·PUMPING·MOVING
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Your septic system is going to back up, right? Well you don't have to helplessly wait for it to happen. Simply flush RID-X® down your toilet every month.

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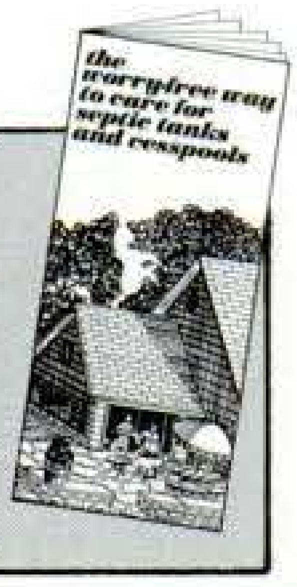
the worry-free way to care for septic tanks and cesspools

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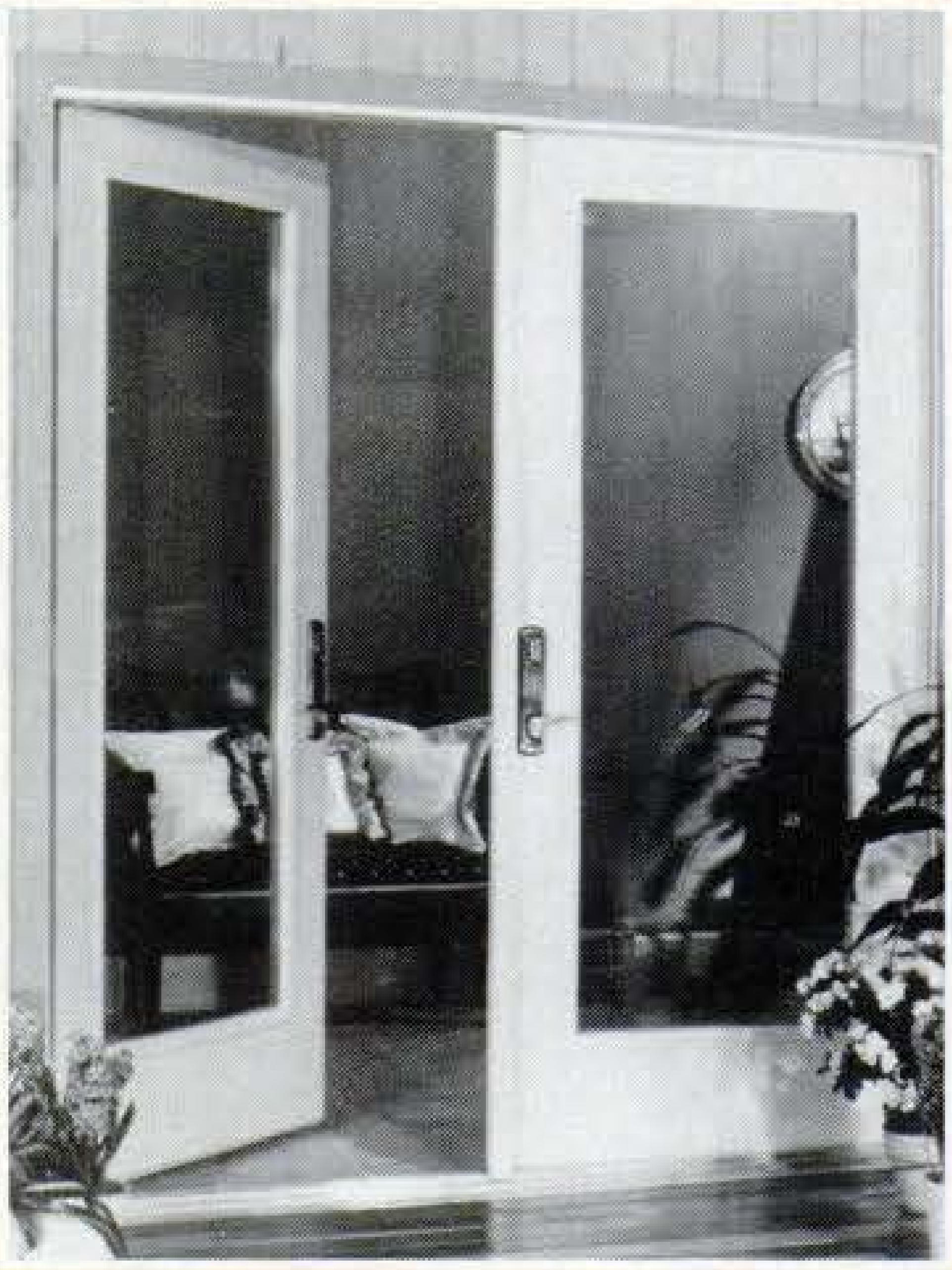

Pull-out patio-door divider

When the delivery men show up with your new overstuffed sofa or you've got shoulder-to-shoulder guests on the patio, wouldn't it be nice to have an extra-large portal into the house? That's just one asset of the Homestead Patio Door (Pease Industries, 7100 Dixie Hwy., Fairfield, Ohio 45014).

The insulated steel doors feature a unique removable astragal, the vertical piece that bisects the door opening. In most patio doors the astragal is nailed to one door. In the Homestead door the divider is bolted to the header and recessed into the sill. The astragal acts like a frame's side; when both doors are shut, you get the strength and security of two single doors. Take out the astragal (just pull down the bolt to free it), and you've got a full 6 ft. of unobstructed access through which to move people and furnishings.

Installation is easy: The doors fit into an adjustable frame. By setting the six two-piece screw-in fasteners, called Jamb-Jacks, that secure the unit, you can fit it into an unsquare house frame. There's no need for shims—the fasteners allow up to an inch of play.

Homestead doors are side-hinged for a traditional French look, and there's an optional 15-light grille, which enhances the appearance. The doors are available to fit a 5- or 6-ft. span. Price: $500 to $600.

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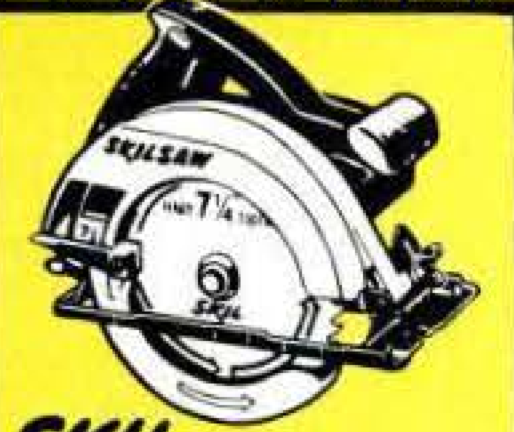
Because Trustworthy stores vary in size, some may not stock all items shown. Prices may be slightly higher in Alaska and Hawaii. Sale prices good through April 30, 1986.



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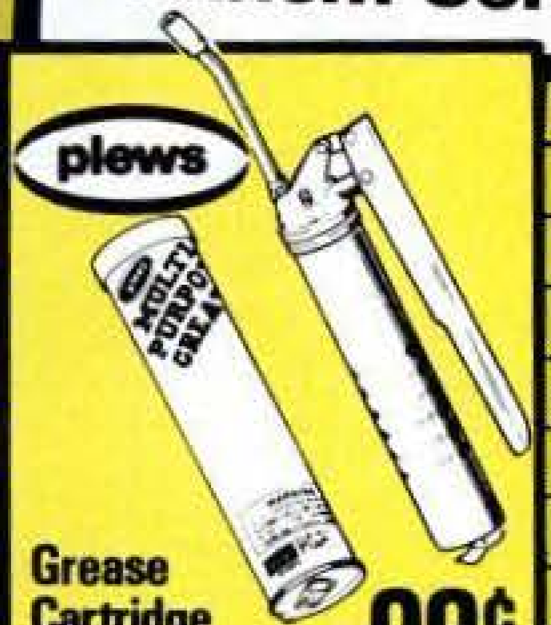

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Grease Cartridge $99¢$
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Grease Gun 6^{99}
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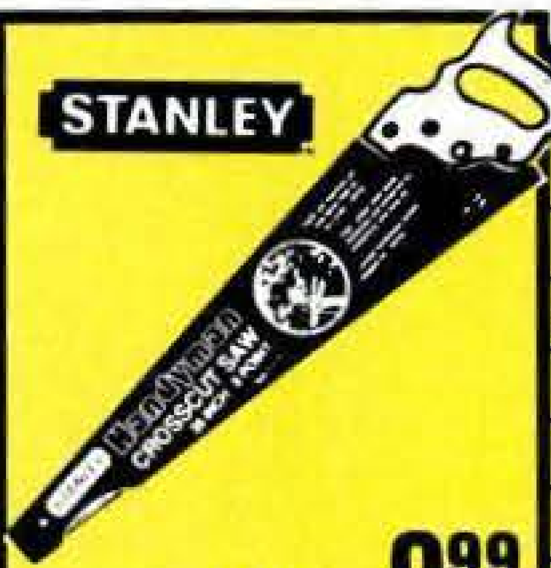

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Crosscut Saw 9^{99}

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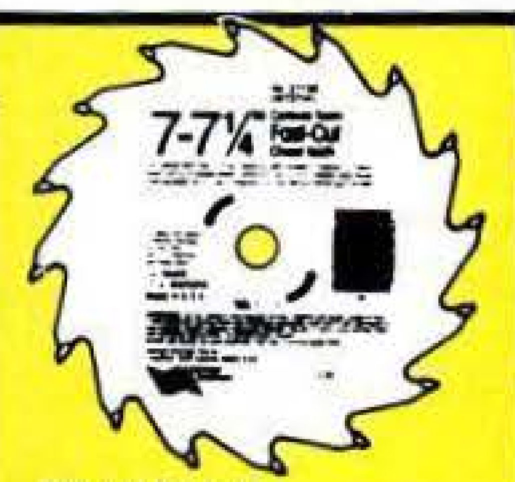

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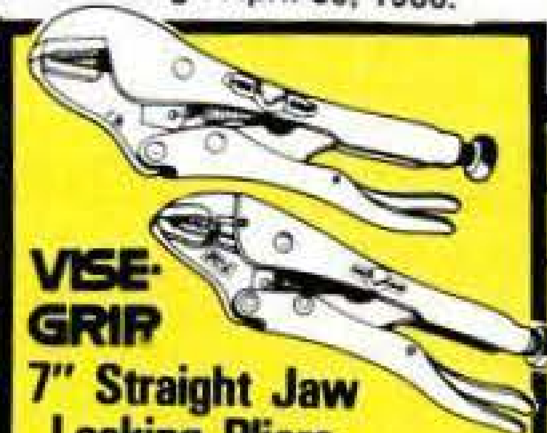
7-7¼" 16 Tooth Carbide Blade 3^{99}

Cuts plywood, particle board & solid wood where a smooth finish is not required. 27150



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5" Locking Pliers With Wire Cutter
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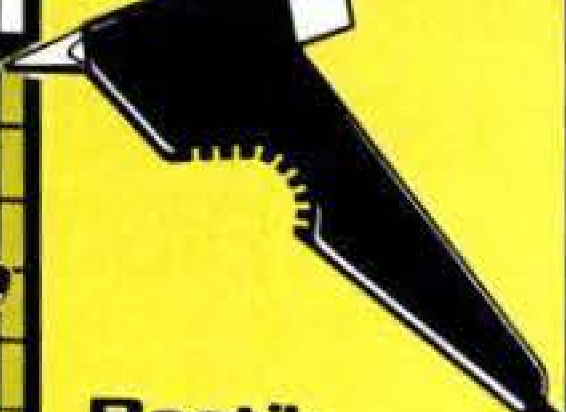

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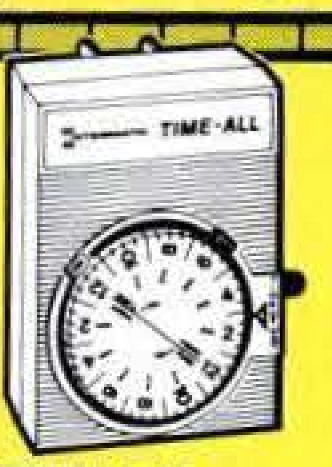
Thermogrip® Glue Gun 8^{88}

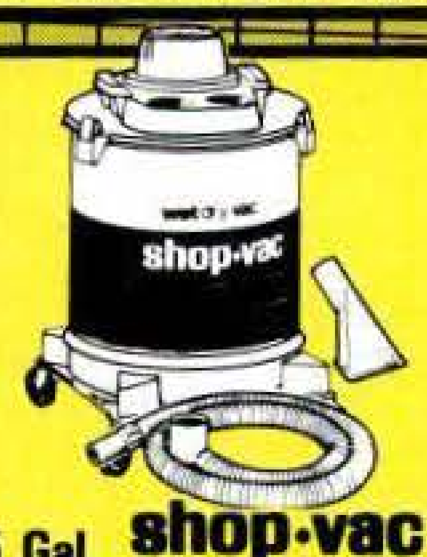
Electric hot melt adhesive tool permanently bonds in 60 seconds. 203



INTERMATIC.

Time-All® Automatic Timer 4^{99}

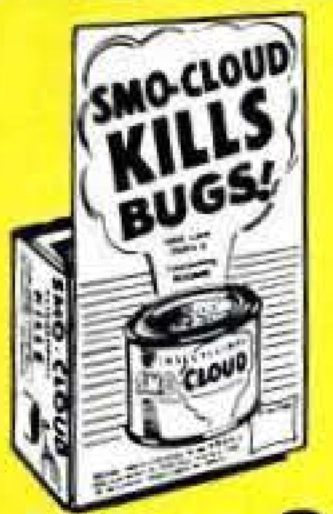
Simulates a lived-in appearance by turning lights and appliances on and off. D111



shop·vac

5 Gal. Wet/Dry Shop Vac 39^{88}

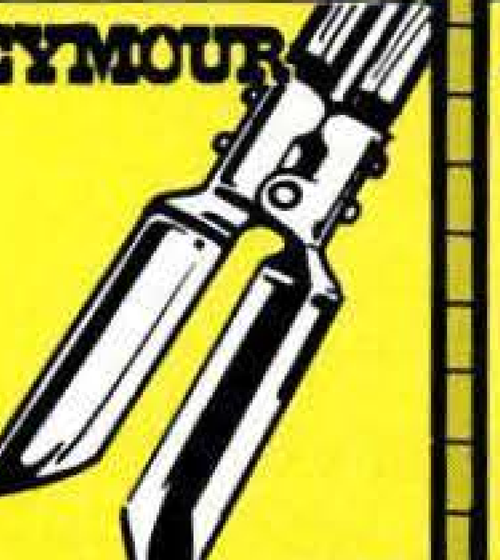
High performance motor vacuums wet or dry, indoors or out. 600-30-4



Smo-Cloud Bug Killer 2^{99}

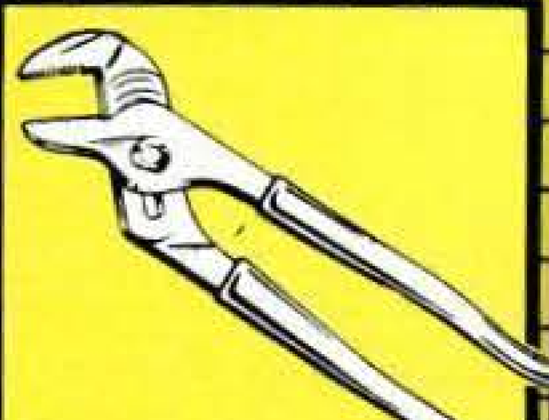
Seeps into cracks & crevices to destroy bugs & nests. One can does 3 rooms. 495-6

SEYMOUR



Post Hole Digger 8^{67}

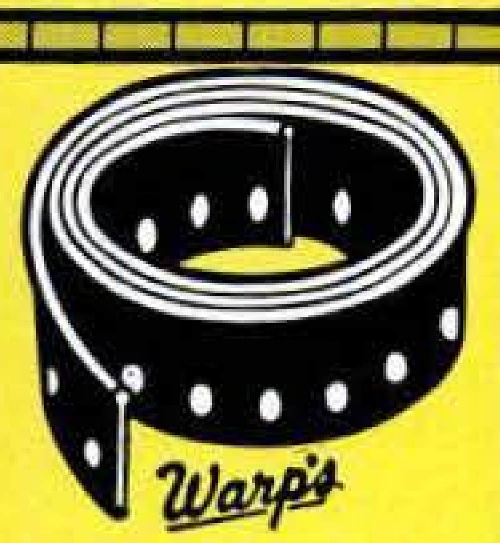
48" hardwood handles. 9" steel blades. DG-50



Crescent

10" Groove Pliers 6^{99}

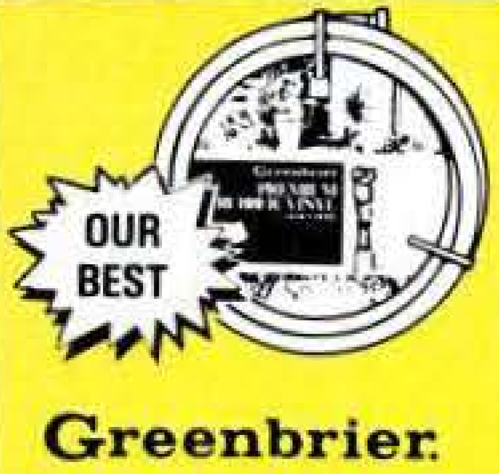
Drop forged steel. Long handles for powerful leverage. R210CV



Warp's

4" x 20' Plastic Lawn Edging 3^{99}

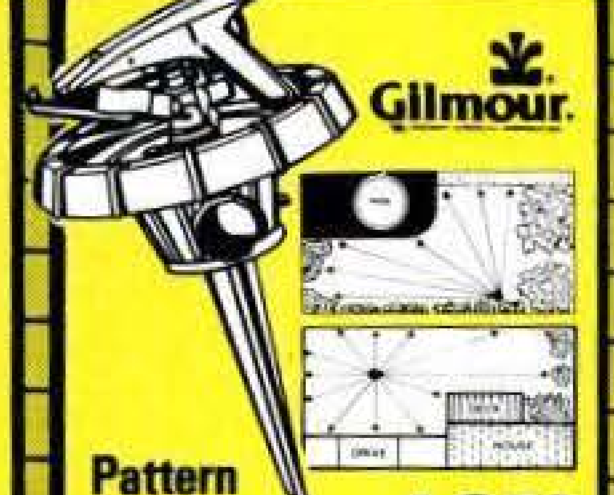
Divides beds and gardens, lines driveways and paths. BD420B BD420G



Greenbrier.

5/8" x 50' Reinforced Rubber/Vinyl Hose 12^{99}

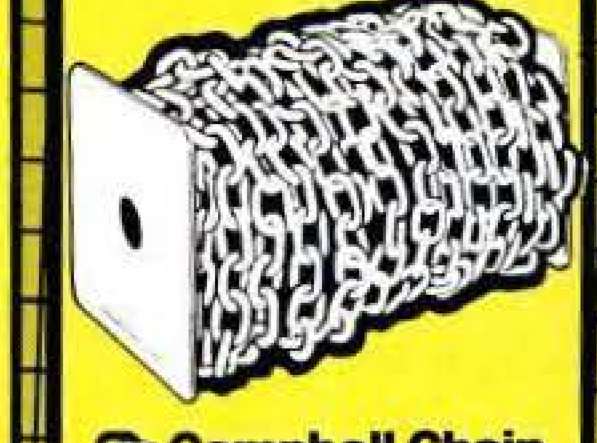
Remains flexible even in colder temperatures. 51811



Gilmour.

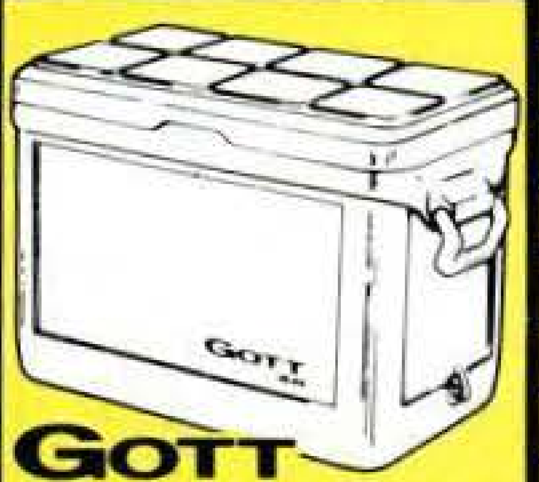
Pattern Master™ Sprinkler 12^{99}

Water many shapes—simple to complex. Simply program & water. Spike base. 996S



Campbell Chain

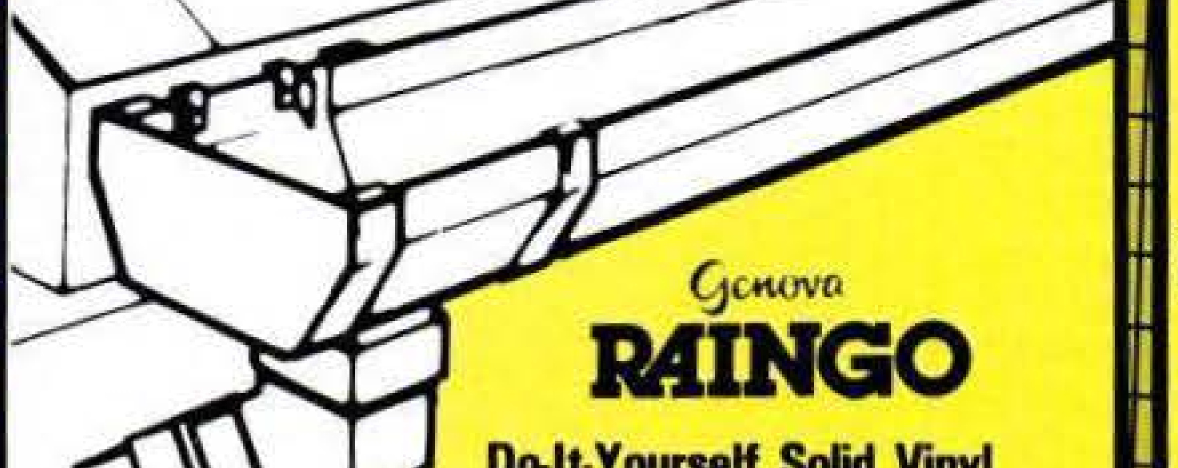
1/4" Blu-Krome Proof Coil Chain **ON SALE**
072-5127



GOTT

Sportsman 48 Cooler 19^{97}

Big 48-qt. capacity. Removable food tray, hinged seat-top lid. 1948

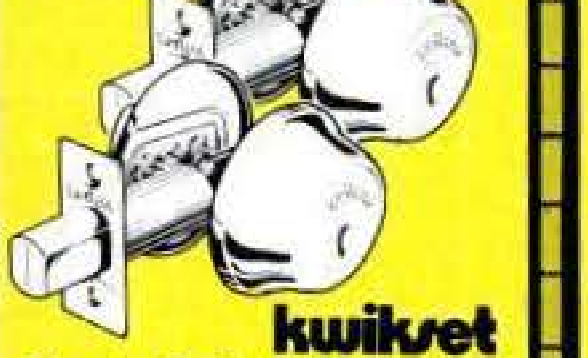


Genova

RAINGO

Do-It-Yourself Solid Vinyl Gutter and Downspout Systems

10' Gutter 3^{99}
RB-100, RW-100

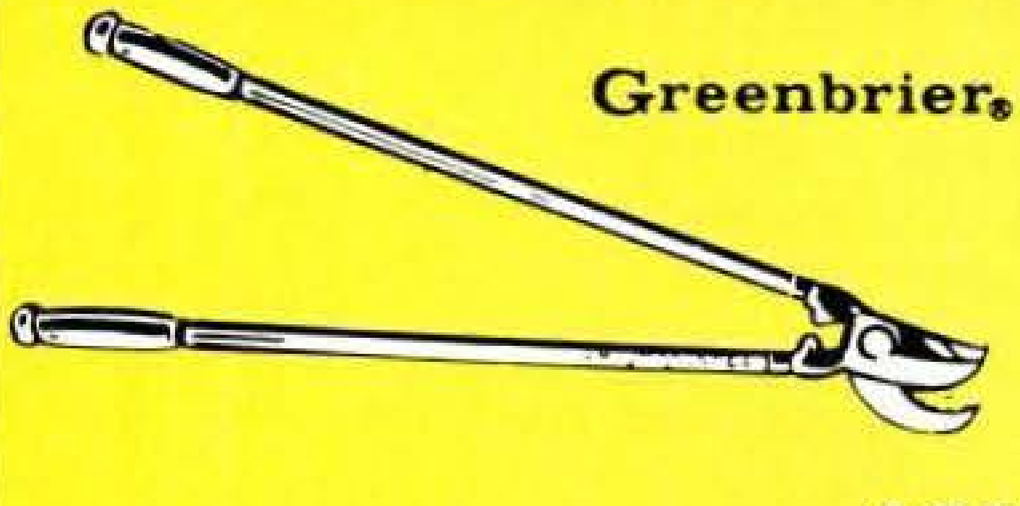


kwikset

Single Cylinder Deadbolt 7^{99}
660-3

Double Cylinder Deadbolt 9^{99}
665-3

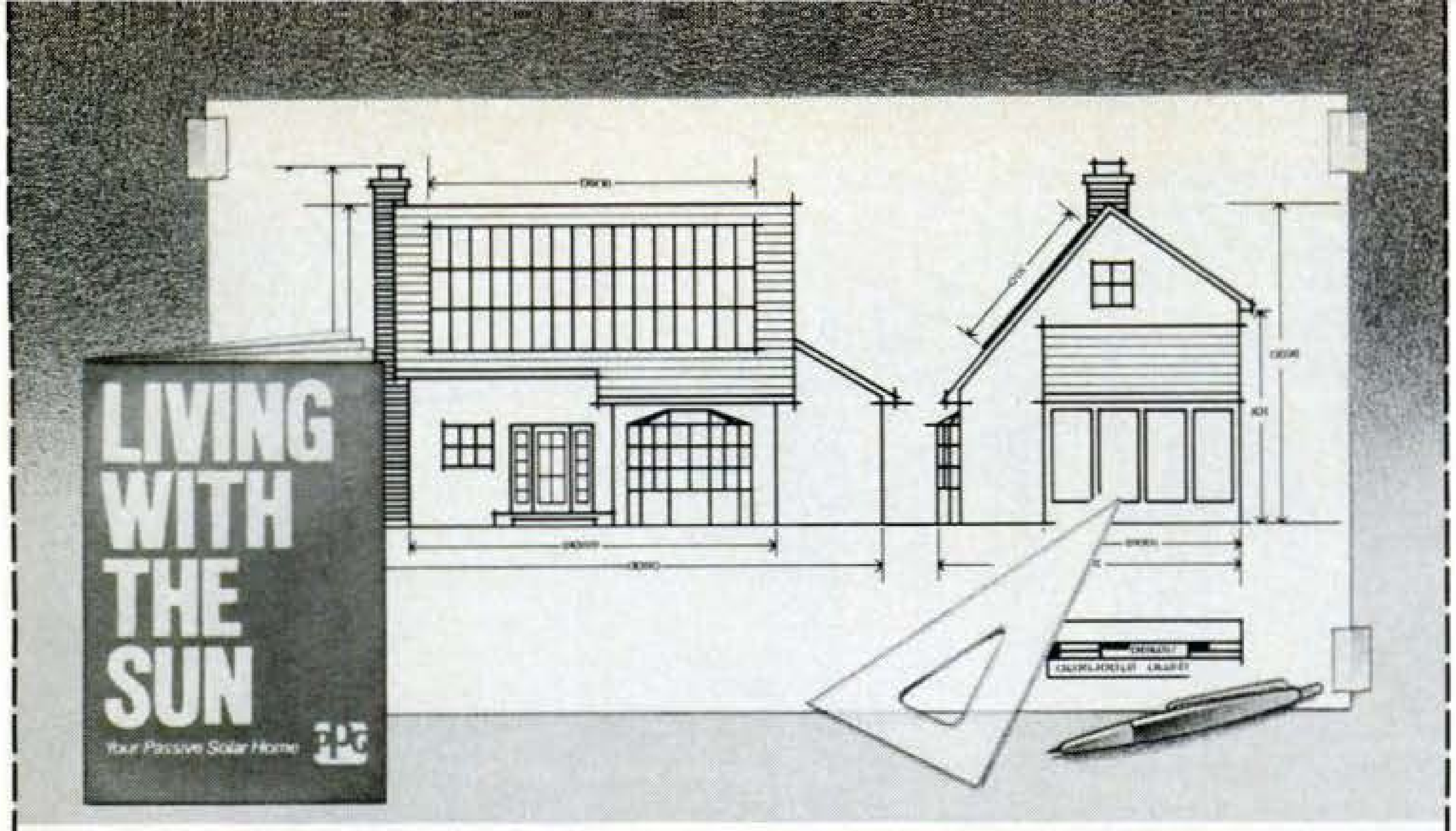
Greenbrier.



Lopping Shears 12^{97}

Steel blade and hook are teflon coated. Tubular steel handles with soft grips. 51269

Sale prices good at participating stores. Check the Yellow Pages for the Trustworthy store nearest you!



BEFORE YOU BUILD, YOU SHOULD KNOW EVERY TRICK IN THE BOOK.

This book's on passive solar homes. Handsome, comfortable homes where many owners report savings on heating ranging from 40 to 80 percent, compared to traditional homes.

No matter where you live, find out how you can design your next home to use free energy from the sun. Send $1.00 to PPG Industries—America's leading glassmaker—for your 40-page, full-color copy of "Living with the Sun." Write: PPG Industries, Inc., Passive Solar Marketing, P.O. Box 8727, Harrisburg, PA 17105.

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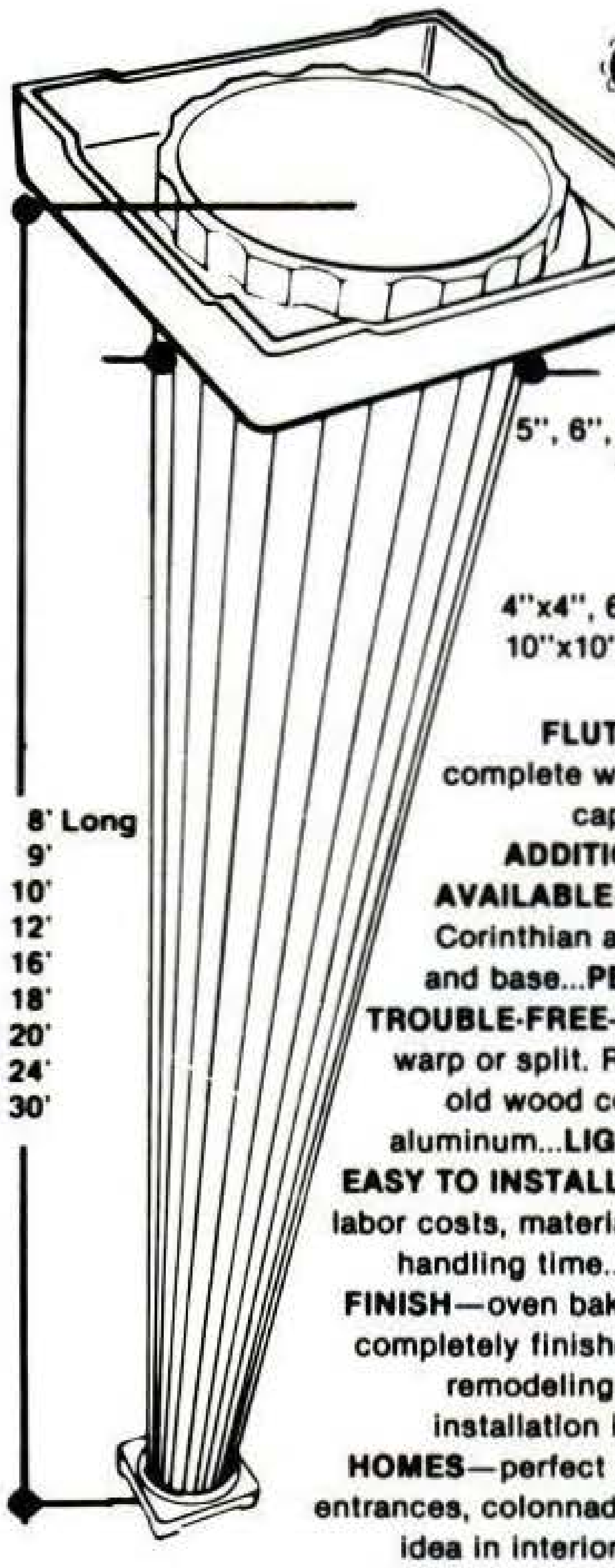
3. Sell spouse on all advantages of aluminum columns.
4. Call factory at same toll-free number and place order for columns to be shipped immediately from stock of 50,000. Use credit card or mail check.
5. Schedule Saturday morning do-it-yourself project.
6. Columns will arrive in approximately 10 days.
7. Arrange for moral support, 2 soft drinks, 1 can elbow grease, hammer, saw, level, and jack.
8. Follow directions and install columns on Saturday morning, eat lunch, then play golf with friends.



ROUND— 5", 6", 8", 10", 12", 15", 18", 24" diameters.
SQUARE— 4"x4", 6"x6", 8"x8", 10"x10", & 12"x12".
SMART FLUTED DESIGN complete with standard cap and base... **ADDITIONAL CAPS AVAILABLE**—Scamozzi, Corinthian and split cap and base...**PERMANENT, TROUBLE-FREE**-will not rot, warp or split. Replace your old wood columns with aluminum...**LIGHTWEIGHT, EASY TO INSTALL**—cut down labor costs, material costs and handling time...**BAKED-ON FINISH**—oven baked columns completely finished for home remodeling when quick installation is required... **HOMES**—perfect for porches, entrances, colonnades — a new idea in interior decorating.

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New products for YOUR HOME

NEW!
Dad's EASY SPRAY
Professional Strength
Paint & Varnish Remover
SPECIAL SPRAYER INCLUDED!
Dad's EASY SPRAY

Powerful paint remover

After six different brands of aerosol spray and brush-on finish removers, a pair of heat guns, and a good deal of laborious scraping failed to strip three layers of old paint off my birchwood kitchen cabinets, I became skeptical of paint-removal techniques and products. Each one left a stubborn white haze on the stripped surface, which had to be sanded off.

So when a sample of Dad's Easy Spray came my way, I treated it with the same skepticism I'd developed earlier. Easy Spray is a liquid, water-rinsable finish remover that's formulated for spraying from a non-aerosol trigger sprayer that comes with the can. The manufacturer (Sansher Corp., 733 Coliseum Blvd. N., Fort Wayne, Ind. 46805) claims that the spray will lift *all* finishes from wood, metal, and masonry.

As a test, I sprayed the remover in an area where it was hard to wield the heat gun. After 15 min., I easily scraped off 90% of all three layers. On top of that, the remover remained wet for almost an hour, making it easy to scrape out the corners.

Following directions, I sprayed again, waited 5 min., then scrubbed off the hazy residue with wet steel wool. The result: bare, smooth wood.

For the ultimate test, I sprayed Dad's on the graffiti-marred lamppost outside my house. Within 10 min., I'd cleaned the six posts on my block.

Dad's Easy Spray is $8 a quart; $22 a gallon.—*Susan Renner-Smith*

Save Gas, Save Engine with 'POLY'

The following introduces one of the most fully tested and credentialed gas saving, friction reducing engine treatments ever to reach the market!

WHAT IS POLY? "Poly" is short for polytetrafluoroethylene (TFE). It is the slipperiest substance known to man **(1981 Guiness Book of World Records, p. 188).** The PetroLon Corporation, makers of Slick 50, has invented a way to permanently bind this slippery chemical to your engine with one treatment. All you do is add one quart of Slick 50 to your oil during oil and filter change. By reducing engine friction, Slick 50 increases gas mileage and horsepower and reduces engine operating temperature thus causing your oil and engine to last longer. Just as important, it reduces metal wear, defraying costly overhauls.

HOW DO I KNOW THIS ISN'T A FRAUD? Slick 50 has some very impressive credentials. The **"Consumers Digest"** magazine (March/April 1982, p. 35) states "Slick 50 does reduce engine heat and ordinary wear, and our informal tests indicate that it will improve gas mileage by about two or three miles per gallon.... Slick 50 does exactly what Petrolon claims it does." Researchers at a **nationally respected research laboratory**, after applying a powerful ultrasonic cleaning process to a Slick 50 treated engine part, were surprised at its permanence. They stated, "We actually expected the PetroLon Slick 50 TFE Resin coating to also be removed, but later found it was still there."

The **Federal Aviation Administration** has fully accepted a similar product- Slick 50 Aircraft Treatment (F.A.R. #33.49). An FAA test simulating 1400 hours of engine use (equivalent to about 70,000 miles on a car) showed almost zero engine wear!

"Dune Buggies and Hot VW's" magazine, April 1983, p. 70-71, records the results of their one year testing of Slick 50. "We can indeed say scientifically that Slick 50 does work and that it does reduce engine wear!.... for the price of one treatment when compared to engine rebuild, we feel you'd be money ahead using Slick 50." The senior engineering researcher at the **University of Southern California** in San Diego stated this, "Slick 50 does increase horsepower and decreases fuel consumption in tests done at the university." The **Space Shuttle Columbia** uses the chemical "poly" in its gears and bearings because it is the only chemical lubricant which can withstand the heat and corrosive elements of space.

PetroLon's
INTERNAL
TFE RESIN ENGINE COATING
SLICK 50
FOR GAS AND DIESEL ENGINES
1 U.S. QUART/.946 LITER

Perhaps the most dramatic of all is a torture-test overseen by the **Automotive Services Council for Pennsylvania** and shown on television station WTVE. Three cars with between 75,000 and 129,000 miles on them were treated with Slick 50. Six months later the oil was drained from each vehicle and the cars were driven without the oil plugs for about a half hour. The water temperature never rose and the engines sustained no apparent damage. There are many more tests available. If you are still skeptical, send $2.00 to defray printing and postage costs and we will send you additional, more detailed, test information, etc.

HOW DO YOU TREAT AN ENGINE? Very simply. Just before oil and filter change, add engine flush (sent free with each order) to clean out your engine. Let your engine idle for 5 minutes. Then drain your oil, change filter and add the proper amount of oil less one quart. Add one quart Slick 50, drive for 30 minutes, and leave it in the crankcase for 3,000 miles. As the engine operates, the oil carries the "poly" between the parts where it is burnished into the pores of the metal. Once impregnated it is permanent, so **you do it only once**, not each time you change oil. One quart of Slick 50 will treat all standard 4, 6 and 8 cylinder gasoline and diesel engines.

WILL IT WORK WITH MOST OIL? Yes, Slick 50 will work with all petroleum based oils and all synthetics compatable with petroleum based oils.

WHAT ARE THE BENEFITS OF SLICK 50? Your actual benefits in percentages may vary, depending on the kind of driving you do, vehicle condition, etc. By reducing friction, Slick 50 does all of the following: it **increases gas mileage**. It **increases horsepower** -- small economy cars and large RV's really need this. It makes for **easier starting** (important in cold weather). It **reduces operating temperatures**, thus increasing the lubrication and life of your oil and your engine. Since lubricating lead is being removed from gas and unleaded gas is poor in lubricating qualities, the **extra lubrication of Slick 50 on valve stems and guides is very valuable**. Last, but not least, the drastic reduction in engine wear **defrays or eliminates costly overhauls** which can save you over $1,000. Slick 50 eliminates the "lubrication starvation" that all cars experience when first started before the oil has a chance to circulate. Up to 90% of the wear on a car can be caused by this lubrication starvation. You receive all of these benefits for **less than the cost of two tanks of gas** ($39.95).

WILL SLICK 50 HARM MY ENGINE OR AFFECT MY WARRANTY? No! Slick 50 is suspended in an excellent grade of petroleum oil which meets or exceeds every manufacturers engine warranty requirements. In addition, this oil carries an API (American Petroleum Institute) service classification SF-CC-CD.

DEALERSHIPS ARE AVAILABLE.

OTHER SLICK 50 PRODUCTS available are Gear Treatment (manual transmission, etc.), 2-Cycle Engine Treatment, Grease, Ultra 9 Oil, Fuel Conditioner, and Fabric Protector. Free information is sent upon request.

EASY TOLL FREE NUMBER. Since Slick 50 is **"too too Slick"** for engine friction, our toll free number is 1-800-22-SLICK (that is, 1-800-227-5425).

Free engine flush sent with each order. Free shipping with orders of 2 or more.

For purchase or further information call toll free 1-800-22-SLICK, (in Colorado, call 1-303-667-1715) or send to: FORT MORGAN SLICK 50, 407 Del Rio Road, Berthoud, Colorado 80513.

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PS4

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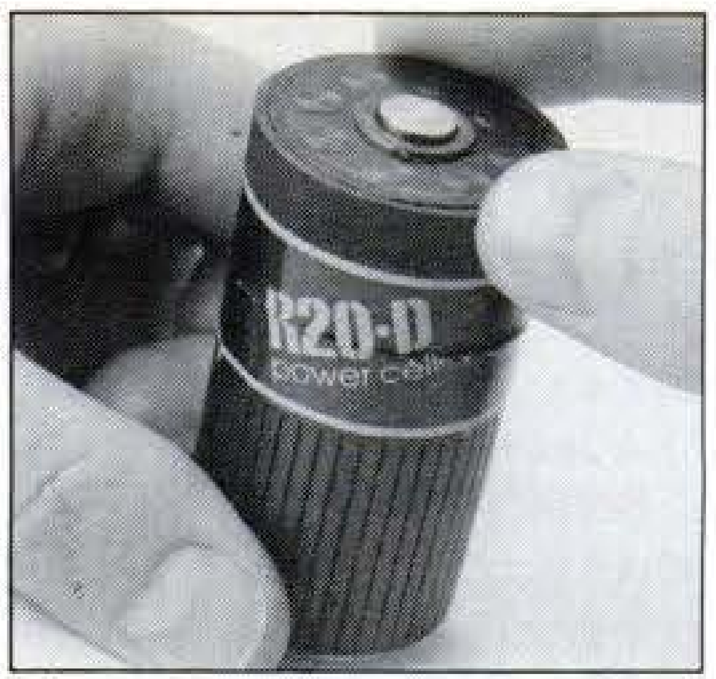
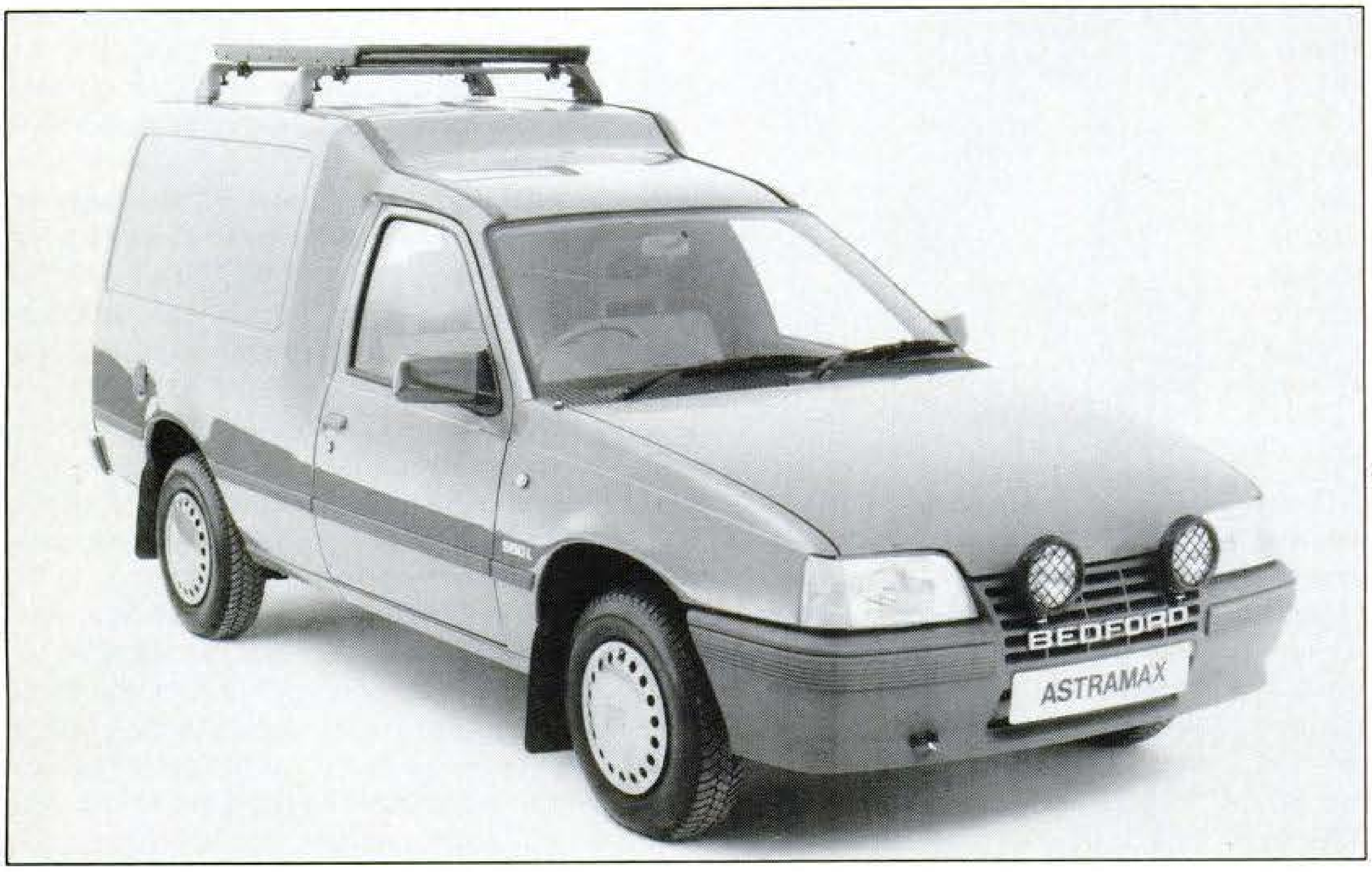
What's New

products/technology



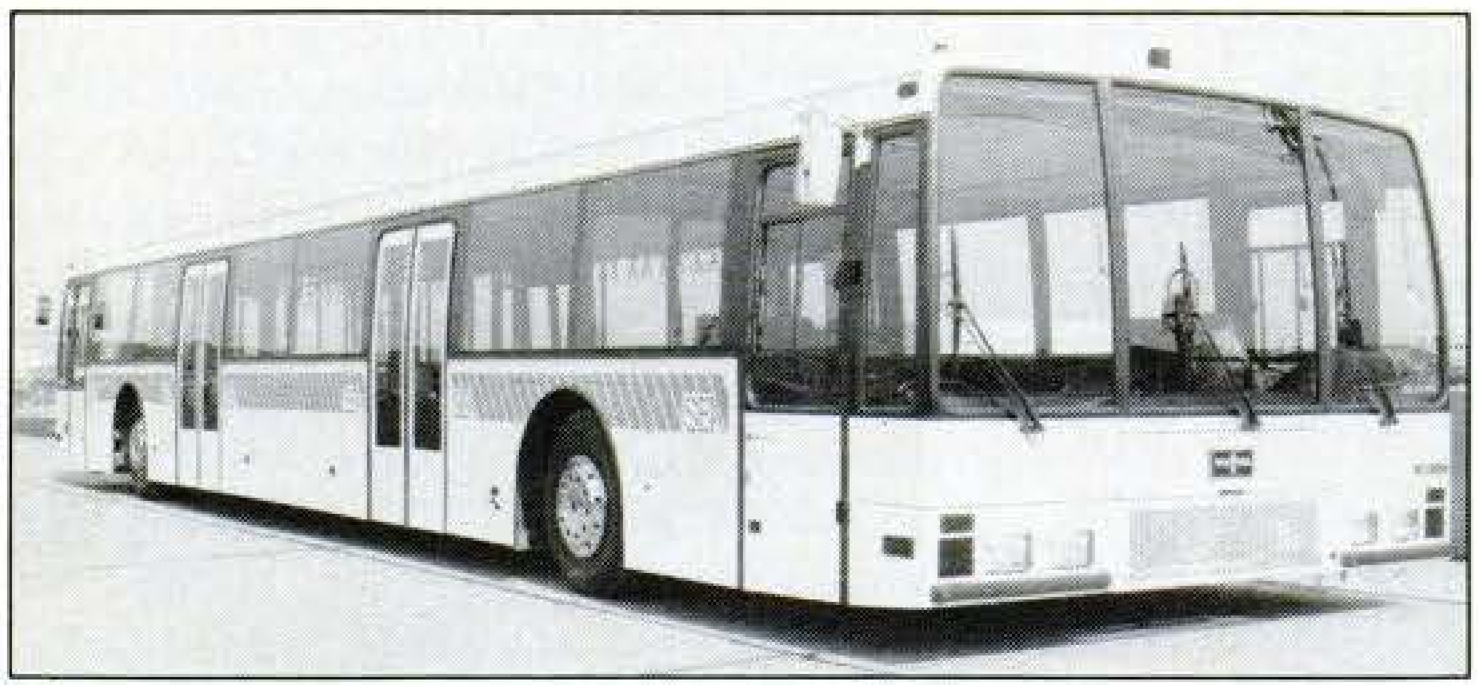
Twist-on dry cell

Even if it's been on the shelf for 10 yrs., when you twist the top of a R20-D Power Cell, it'll be ready in a few minutes. Information on the D-size cells (about $6 a pair) is available from Ultimate Survivor of America (233 Granada Dr., San Luis Obispo, Calif. 93401).



Low-drag van

Bulging rear body panels expand the interior of the Astramax light van to 82 cu. ft. and contribute to the vehicle's 0.34 drag coefficient. Bedford Commercial Vehicles (Luton, England) says the car-derived van's two models have load ratings of 1,090 and 1,565 lbs.

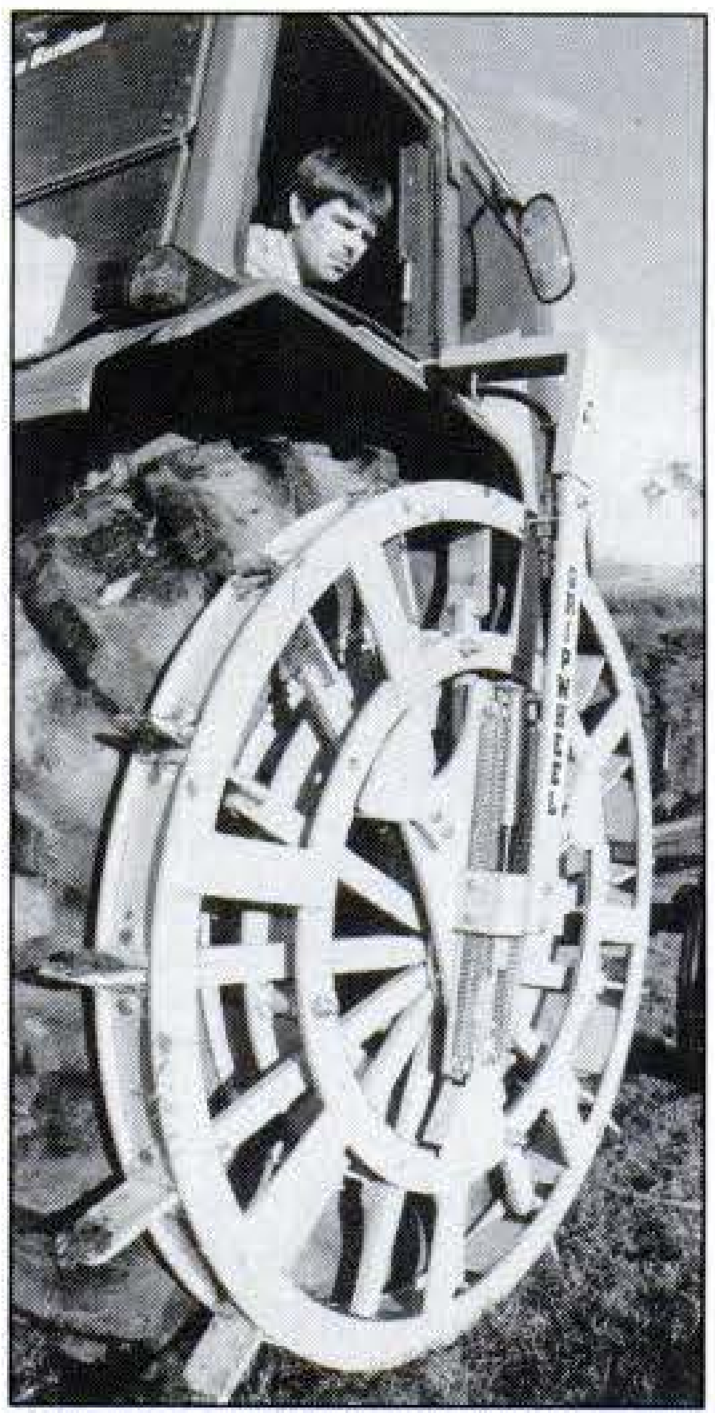


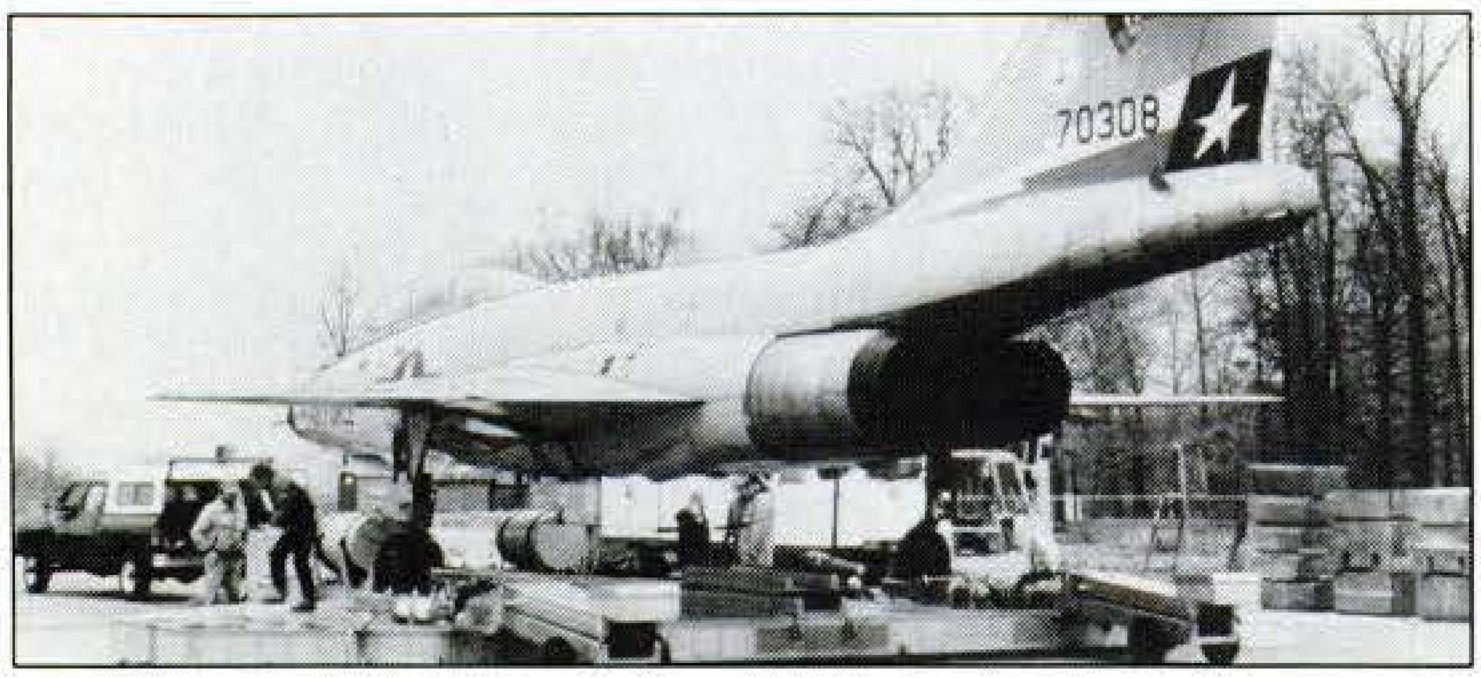
World's largest bus

A giant airport bus carries 180 passengers on shuttles between terminals and aircraft. Built by Van Hool N.V. (Lier-Koningshooikt, Belgium), the 53-ft.-long bus has controls at both ends so turning around is unnecessary. Four-wheel steering improves maneuverability.

Automatic rifle

Greater firepower and accuracy are the benefits of the British Army's new SA 80 automatic rifle. The 10-lb. 5.56-mm-caliber weapon fires 650 rounds a minute. It has one-quarter the recoil of its predecessor and better accuracy due to a light-enhancing optical sight.





Aircraft cushion

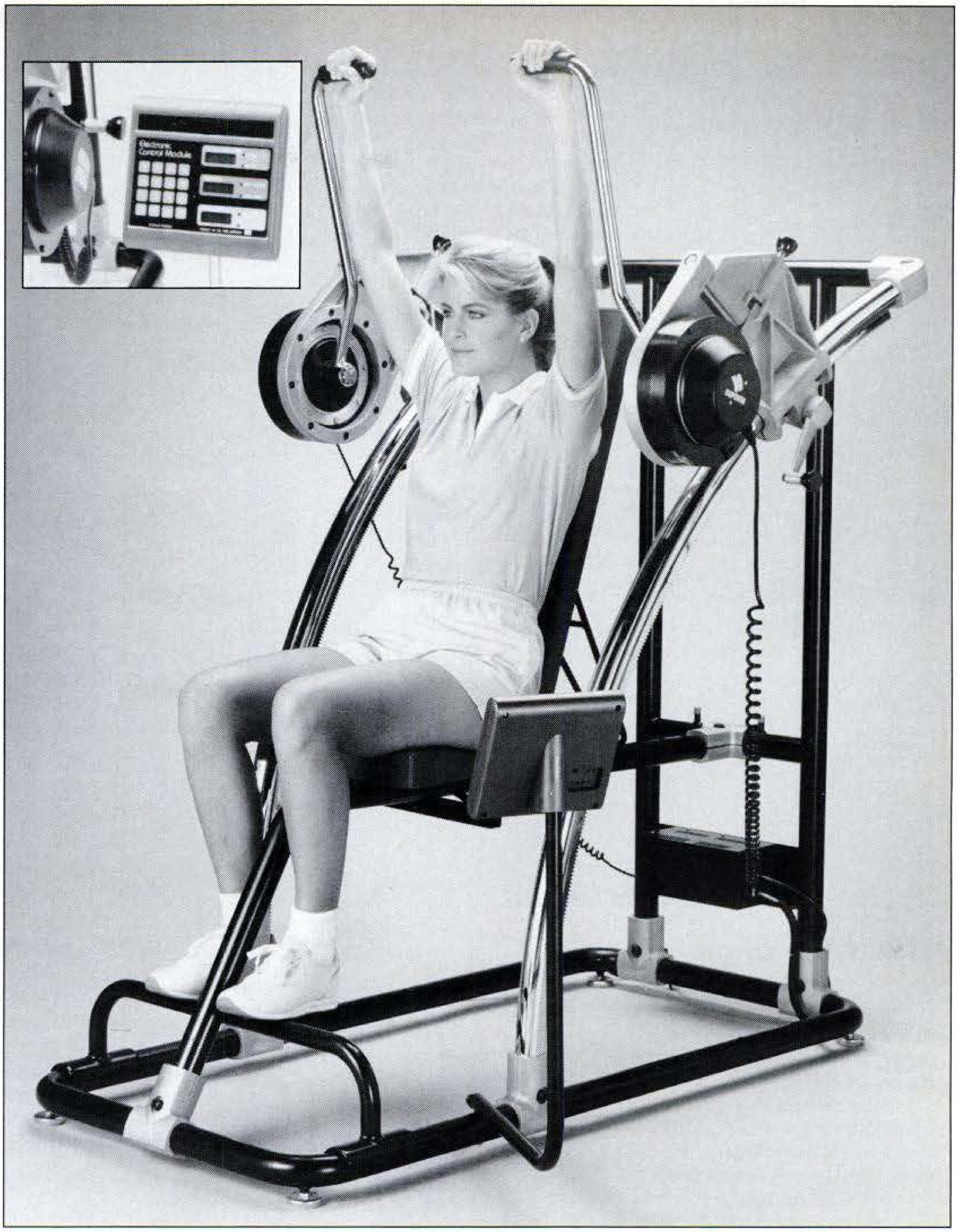
The U.S. Air Force is developing an air-cushioned platform to transport aircraft (shown: a 60,000-lb. F-101 fighter) off damaged runways during battle. The "floating" platform, built by Bell Aerospace Canada Textron, will increase the sortie rate of aircraft in wartime.

Tractor claws

Driving a tractor on slippery slopes is safer with Gripwheel—a series of hydraulically activated strakes bolted to a tractor wheel that dig into the mud for improved traction. Made by H. Cameron Gardner Ltd. (Stroud, England), it retracts for driving on roads.

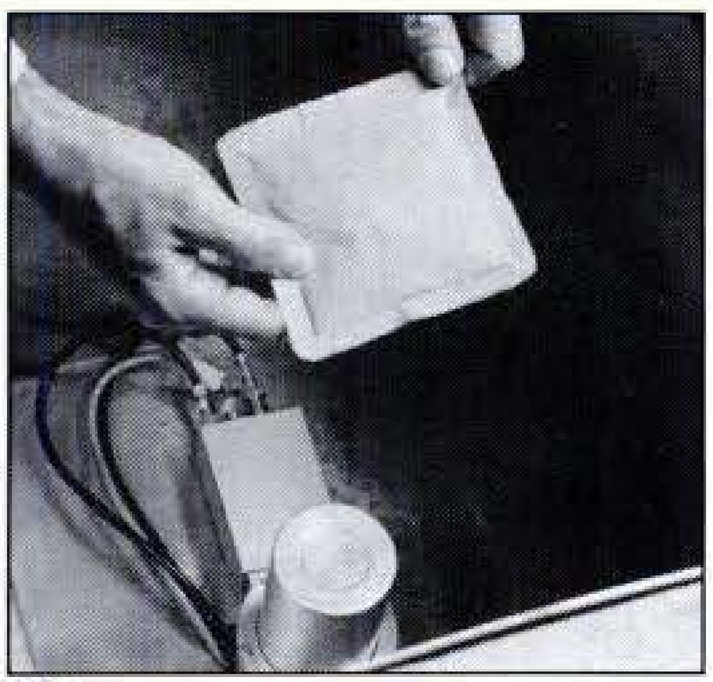
No-weight machine

Isopower is the first multifunction electronic exercise machine, says Toro (8111 Lyndale Ave. S., Minneapolis, Minn. 55420). Instead of weights, it uses electromagnetic-resistance units to supply the workload. You punch in the amount you want on the key pad (inset). $5,000.



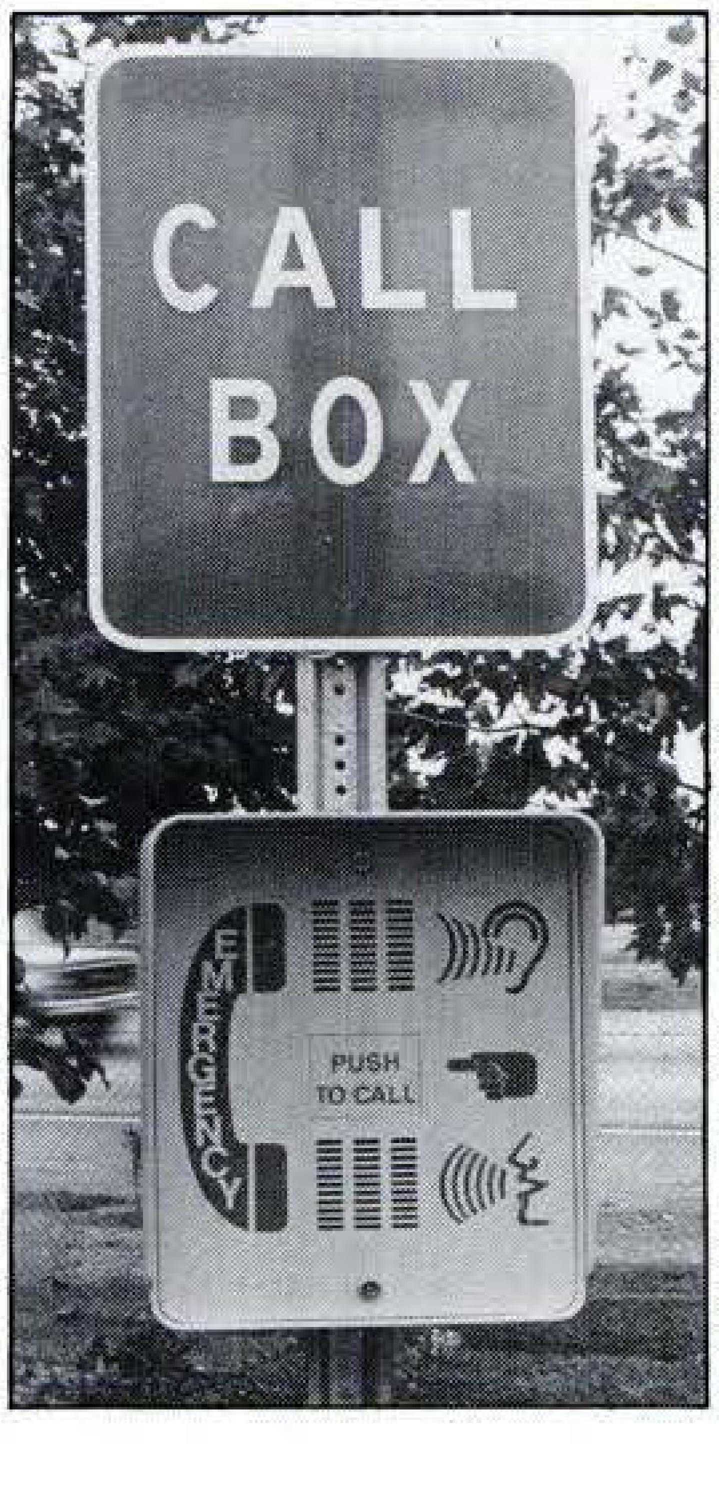
Helpful Parisian

Tap in any street address in Paris on the key pad of this stranger-friendly sidewalk computer, and it issues a printout of how to get there—on foot or by public transportation. A dozen of these electronic address finders called Situ have been installed in the French city.



Radon checker

You can check your house for radon, a cancer-causing gas, with Air Chek (Box 100, Penrose, N.C. 28766; phone 1-800 CK-RADON). You place the charcoal-filled packet in your home for four days, then return it for analysis. Regular service costs $20; a speedier reply is $30.



Solar cellular

A cellular roadside call box from Cellular Message Systems (18261 W. McDurmott, Irvine, Calif. 92714) can be placed anywhere there's a cellular network. It uses sophisticated circuitry to strip noise from the signal and to diagnose its own ills. Solar cells charge the battery.

Racy turbo

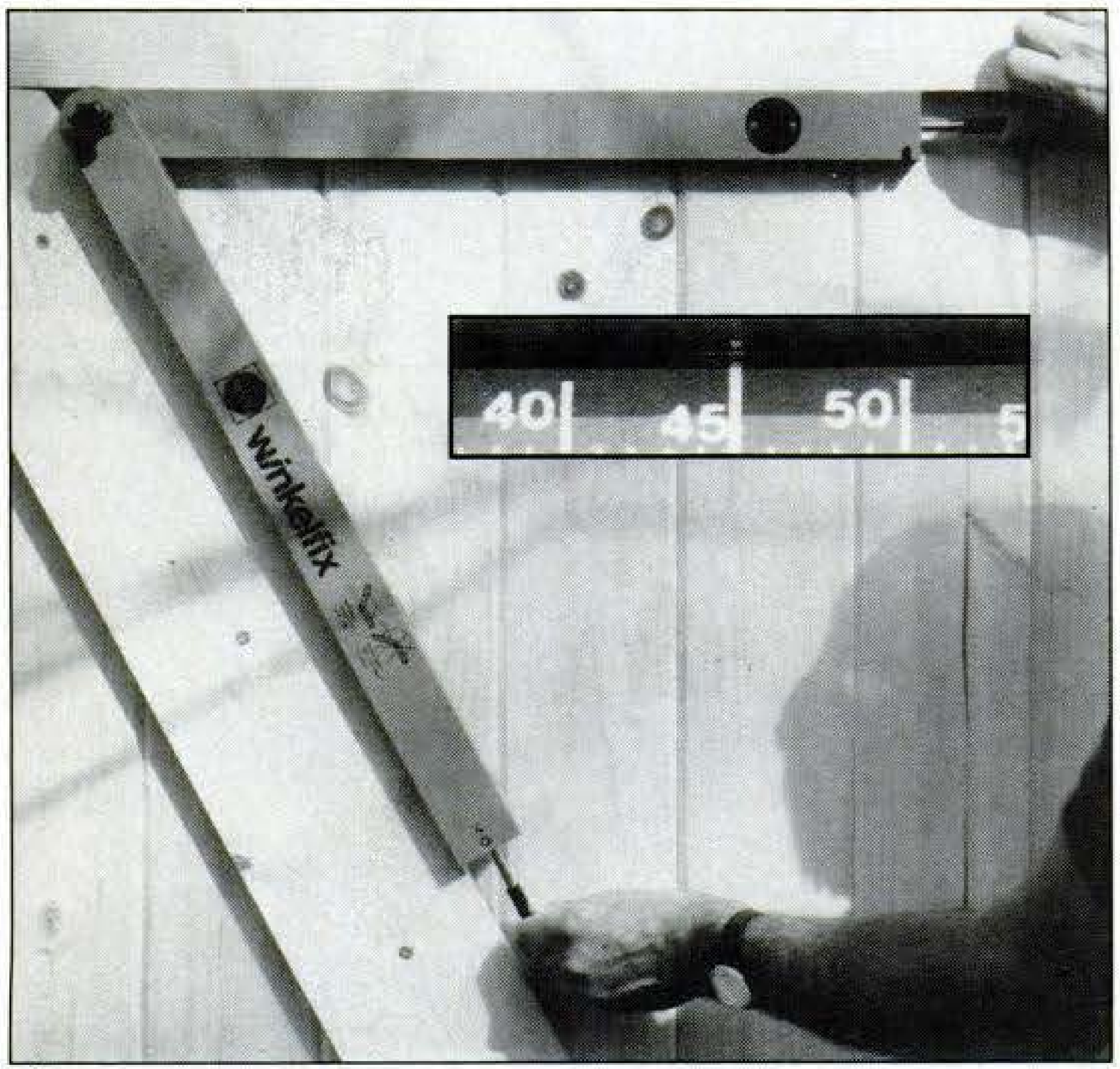
Mitsubishi's new Eurosport ESI-R has an intercooled turbo engine that produces 176 hp and 223 ft.-lbs. of torque. Race-car-inspired body has integral fender flares and side-sill extensions. The $17,299 car has larger tires in the rear than in front, which improves handling.

What's New *in Tools*

BY V. ELAINE GILMORE

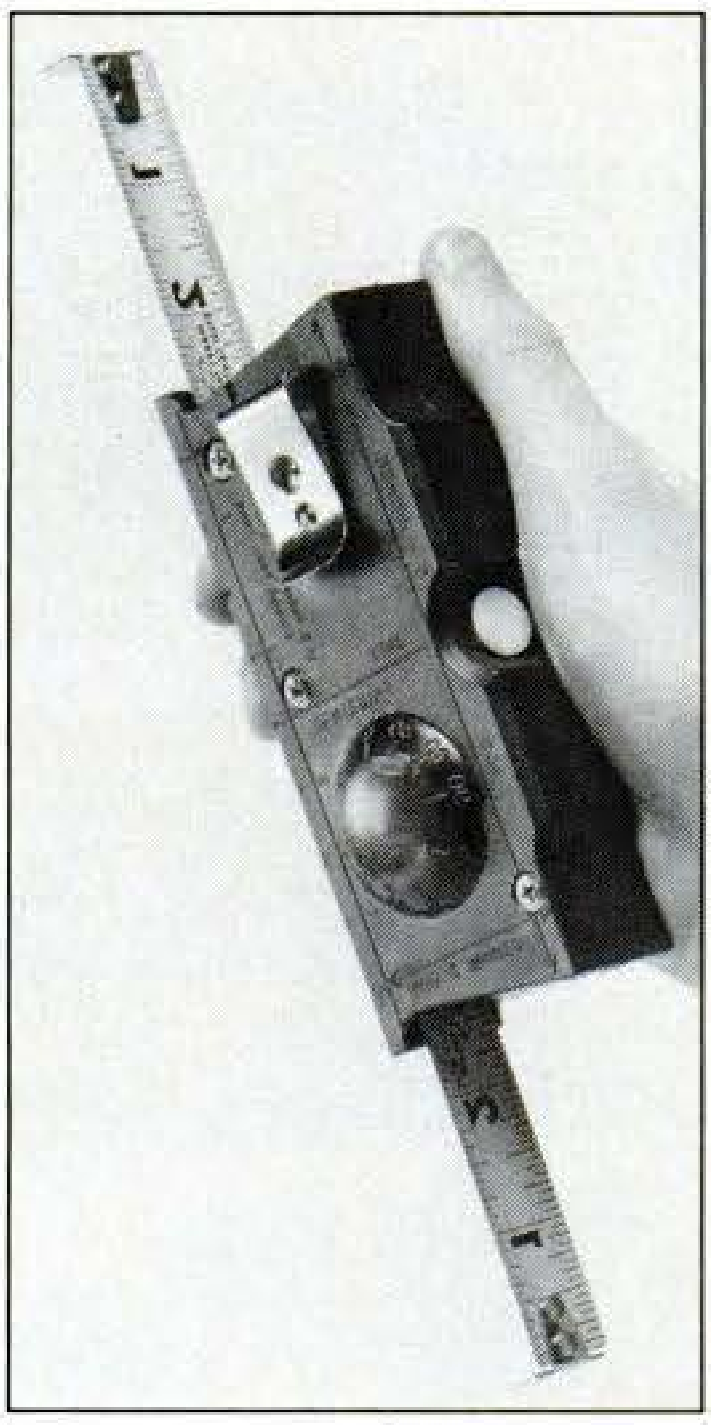
Weed cutter

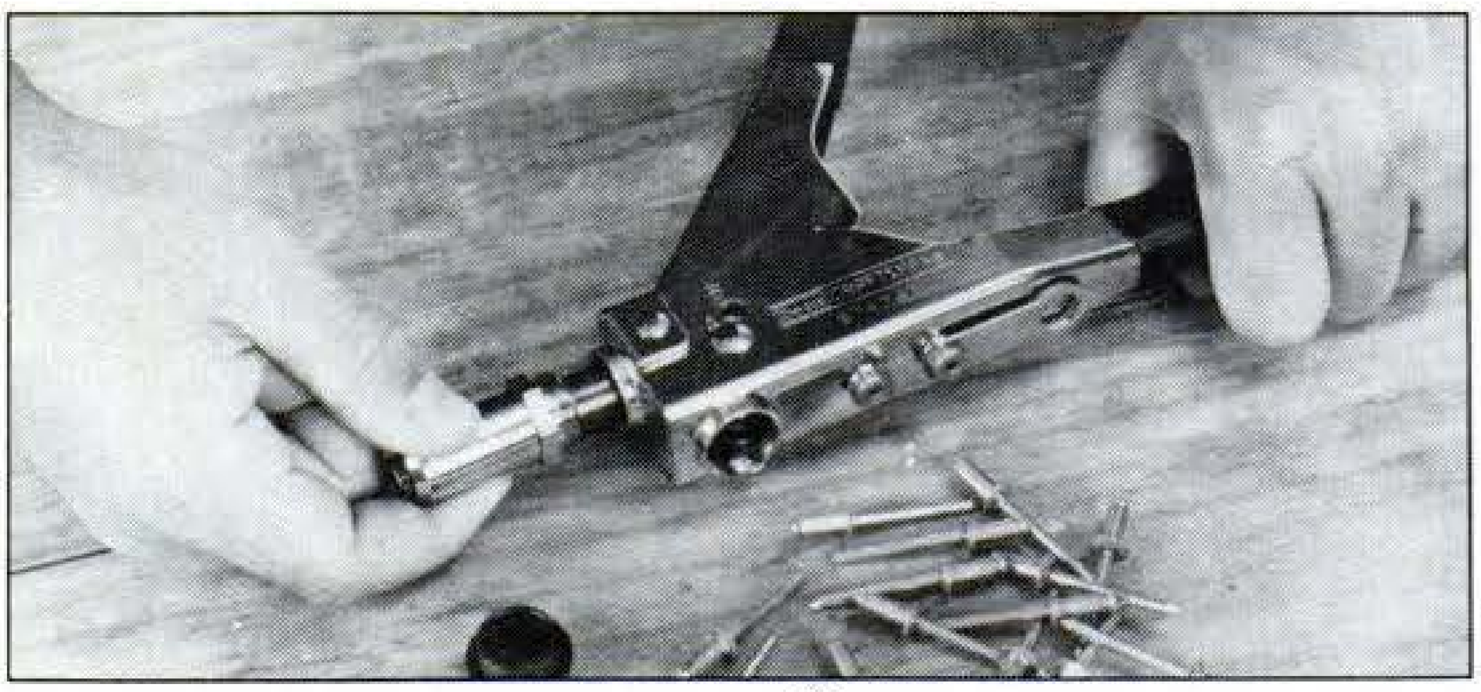
A see-through 16.9-oz. fuel tank on Black & Decker's gasoline-powered weed trimmer lets you know when the gas is low. The model 82257 trimmer cuts a 17-in. swath and features an automatic bump string feed, automatic clutch, and electronic ignition. The price: $204.



What's the angle?

You can find out with this German-made angle finder. Just position the tool to any angle from 0° to 180°, and the readout (inset) on one leg tells the angle. Bubble glasses show level and plumb. The Fine Tool Shops, Box 1262, Danbury, Conn. 06810; $90 (plus shipping).





Middle marker

You can quickly locate a midpoint by extending this tool's two 12-ft. tapes to the same length. To mark the spot, just plunge the pin that's centered in the case. The E-Z Two Tape Measure (1609 Magnolia Blvd., Burbank, Calif. 91506) includes a full-circle level; $21.70.

Riveting idea

The business end of the Sears Craftsman Two-in-One Riveter fits on the side or the top of the steel tool, so you can hold the riveter either parallel or perpendicular to your work. Three interchangeable nosepieces (for $\frac{1}{8}$-, $\frac{5}{32}$-, and $\frac{3}{16}$-in. diameter rivets) come with the $20 tool.

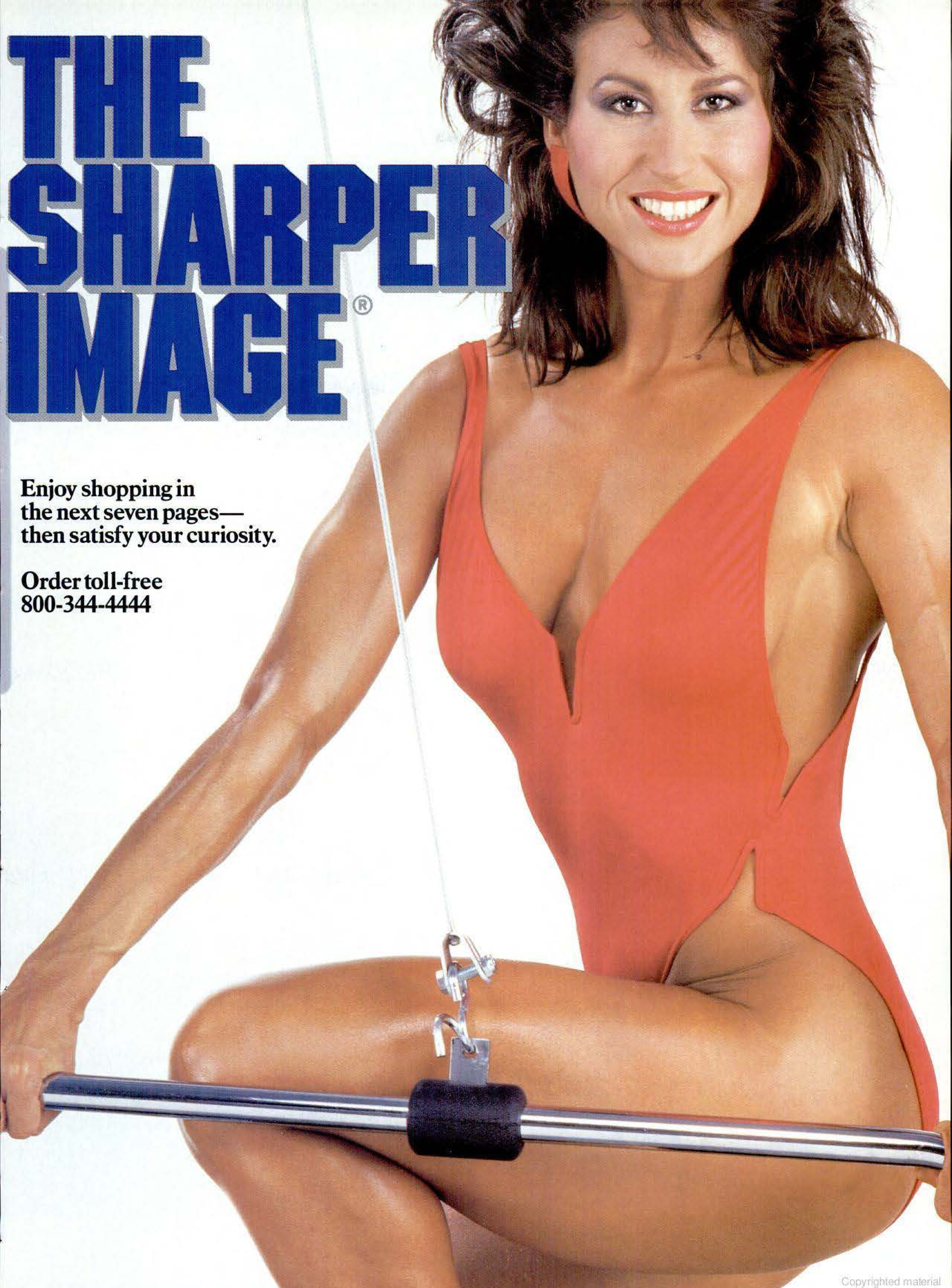
Plane talk

Almost any shop has space for Plane Jane, says Ryobi. Jane (alias the AP-10) is a bench-top planer measuring only 19¼ by 16¾ by 14¼ in., yet it handles 10-in. boards up to 5 in. thick. The $659 planer weighs a transportable 58 lbs., so you can take it to your job site.

Long-life saw

Cylinder walls of the Homelite 290 chain saw are impregnated with Nikasil, a nickel-silicon alloy that is said to act as a lubricant and extend the life of the 2.9-cu.-in. engine. The $270 saw takes a 16- or 20-in. guide bar. An improved muffler reduces the din, it's claimed.

HOMELITE
HOMELITE
290



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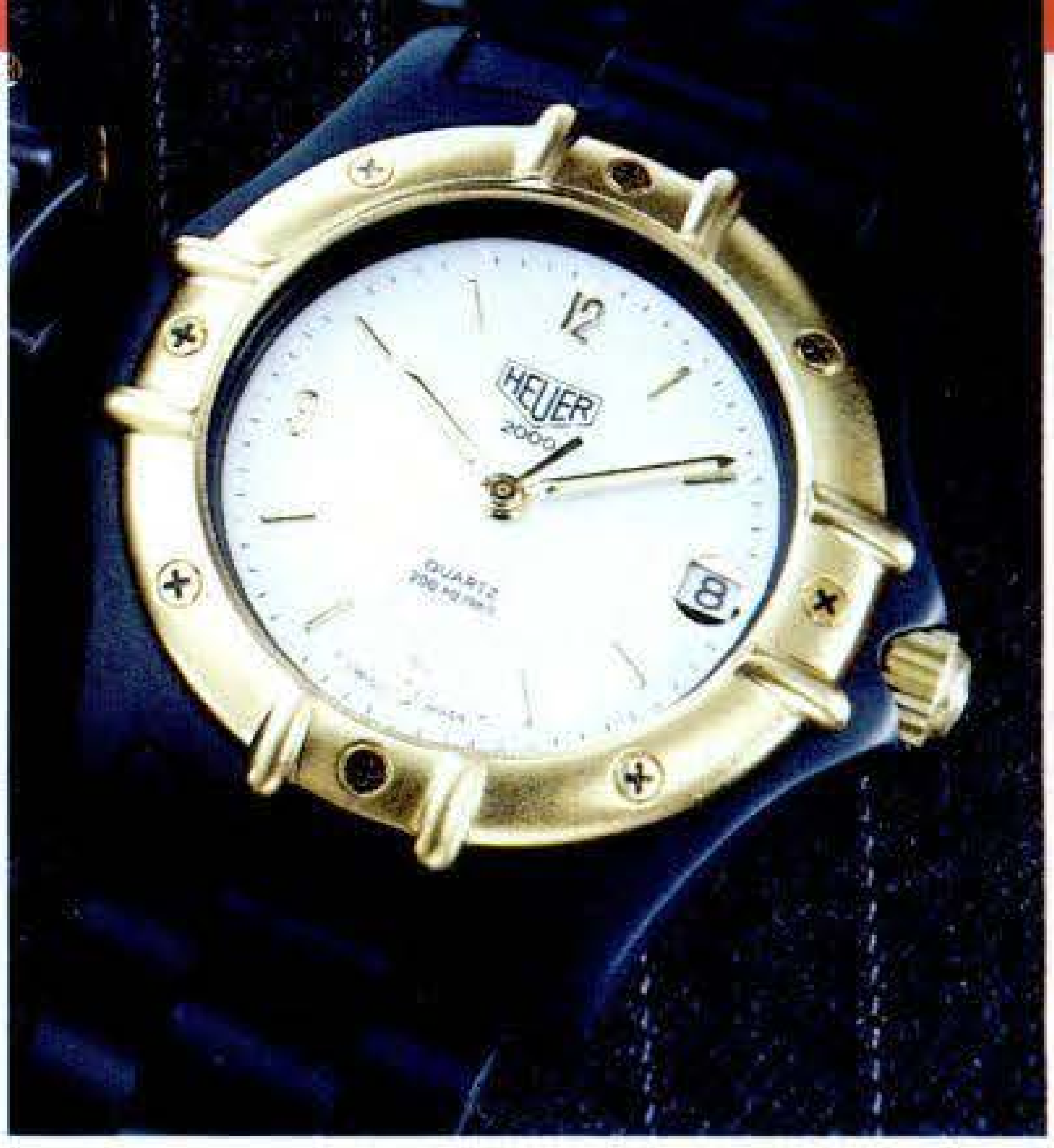
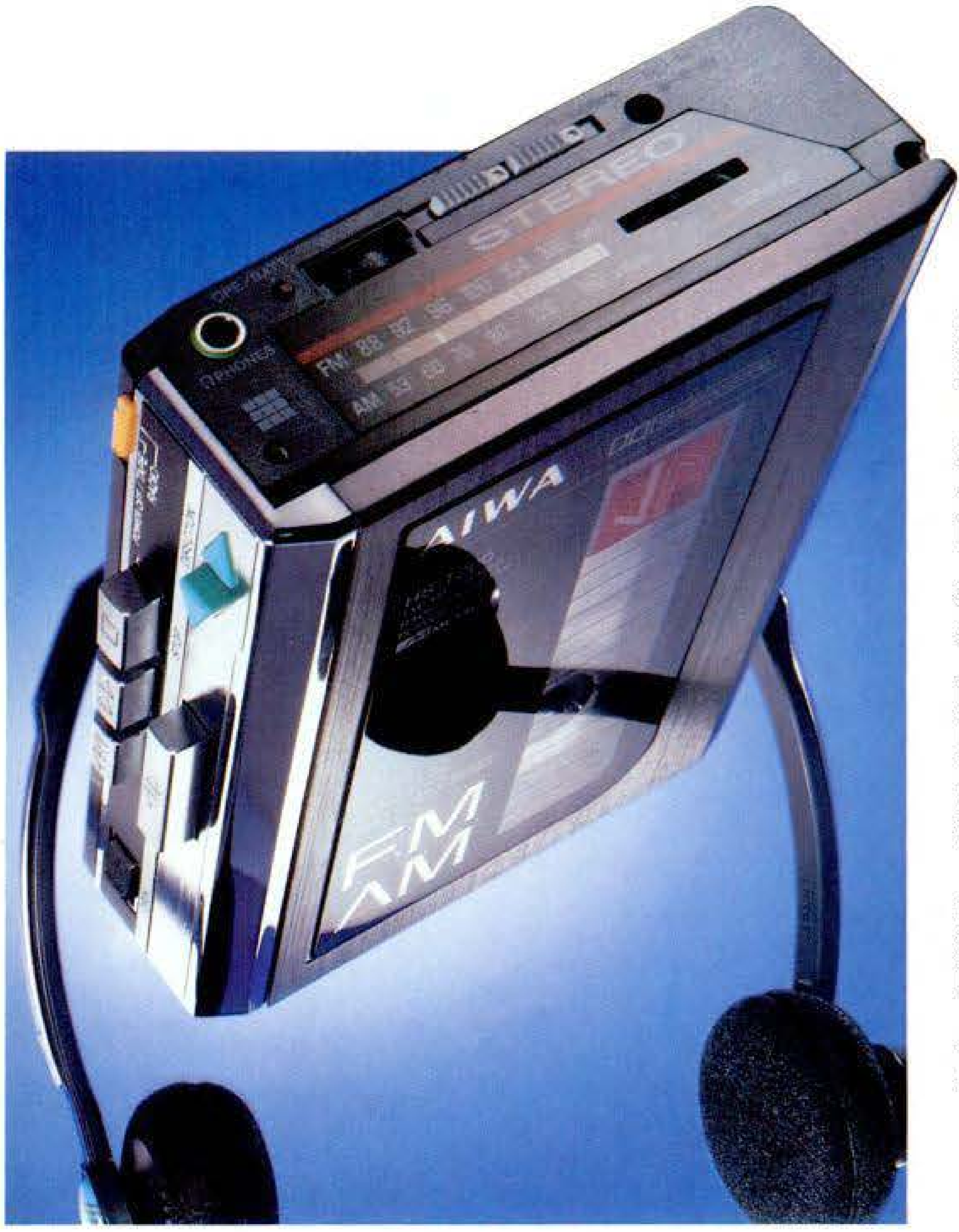
Heuer's newest wrist racer.

A bold new timepiece from Heuer, Swiss watchmaker for kings and sportsmen for over 123 years. Fifteen microns of 18K gold coat the bezel, setting stem, hands and dial markings. Eight gold plated screws fasten the classic bezel. Luminescent hands, sweep second hand. Rugged black anodized case and band are machined of solid stainless steel. The mineral glass crystal is specially sealed for water resistance to 660 feet. Precision quartz movement with ±10 seconds per month accuracy. Comes with a 2-year battery in place and gift case. One-year limited warranty. Also available in an attractive woman's model (not shown).

- **Heuer Black & Gold Watch**
  (Man's) #NHU956 $450 (6.50)
  (Woman's) #NHU958 $450 (6.50)





Aiwa builds $150 performance in an $89 personal stereo.

Aiwa, Japan's most respected electronics innovator, is out to increase its market share. So they're building a high-performance AM/FM stereo cassette player, and offering it at a budget stereo price.

You enjoy outstanding AM/FM fidelity through the lightweight stereo headphones. The receiver is built into the compact case—no separate tuner pack is required.

Built-in Dolby™ noise reduction dramatically lowers tape hiss. You hear pure, clean highs and rich, satisfying bass—from both normal and metal tapes. And tape reversing is automatic—you never have to turn over the cassette to hear the other side. Anti-roll mechanism locks onto the tape for flutter-free music while you exercise.

Just slightly larger than a cassette tape—4½H × 3½W × 1¼D", 6 oz.—Aiwa attaches to your belt with the included clip. Runs on 2 AA batteries (not included). Jack for AC adapter. Comes with headphones and one-year warranty.

Now, Aiwa makes it easier than ever to enjoy state-of-the-art performance and Aiwa's legendary quality. Order today.

- **Aiwa Personal Stereo #NAI920 $89 (3.50)**

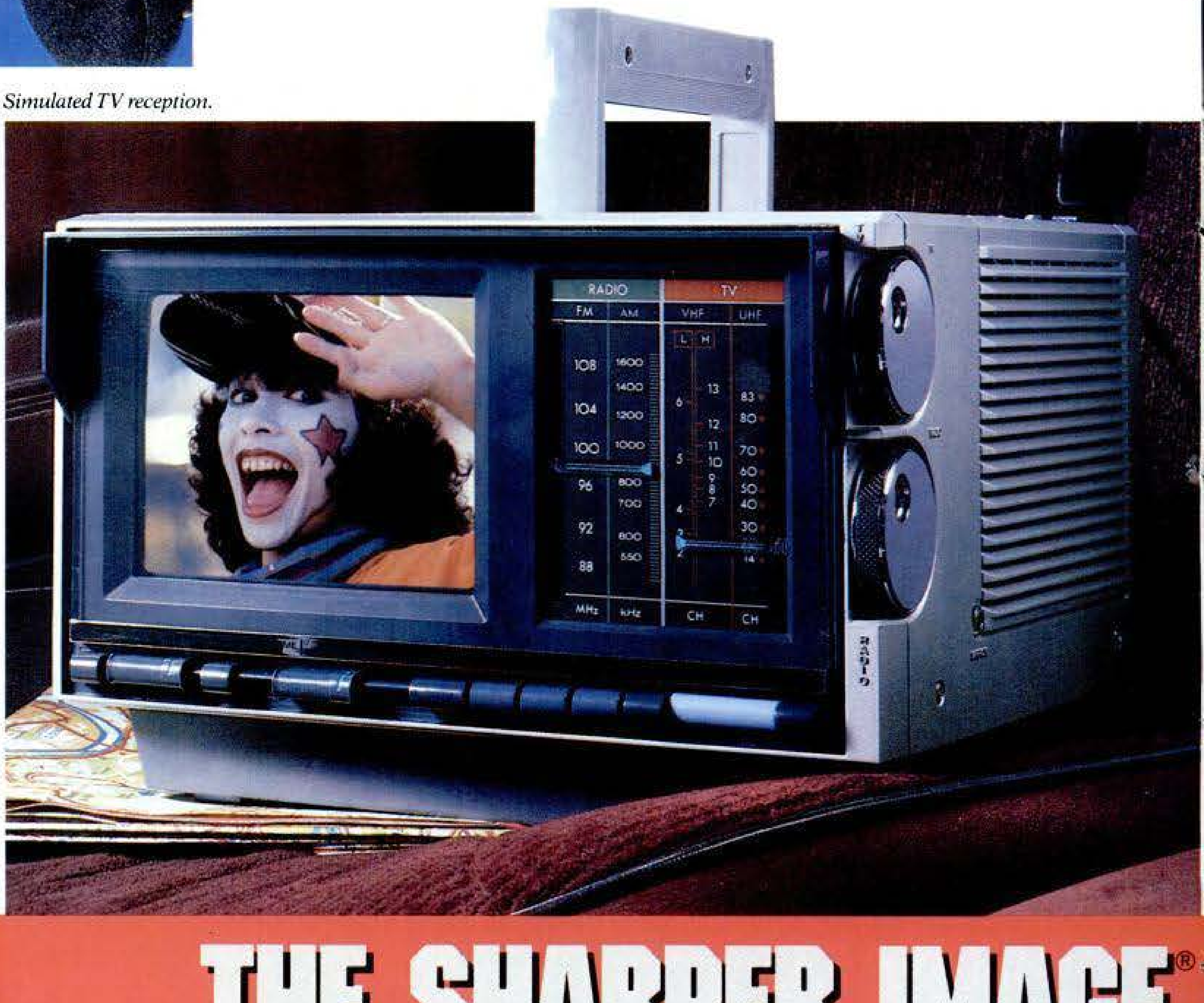
Much more than a color TV. For much less.

Watch your favorite programs in vivid, accurate color on GoldStar's new flat, square 5" picture tube. Or enjoy crisp AM and drift-free FM over the built-in 3¼" speaker. Runs on AC power at home, 12v power in your car, and outdoors on battery pack (see below). Even the recharger is built-in.

Audio/video input and output jacks let you use GoldStar as a TV/monitor with your VCR, video camera or computer. External antenna hook-up. 6¾H × 11½W × 9¾D", 10½ lbs. Comes with power cords, earphone, and *five-year* warranty on parts, 90 days on labor. Order the perfect color TV for home, cabin, boat and camper.

- **GoldStar Color TV/Radio #NGL615 $229 (8.50)**
- **Rechargeable Battery Pack #NXT101 $35 (3.00)**

Simulated TV reception.



Omnibot 2000

Omnibot grows up.

Now a full 26" tall, with articulated head, arm, and flexible wrist, the new Omnibot 2000 will astonish you with his keen mind and agile body.

At parties Omnibot deftly passes hors d'oeuvres, then tends bar and plays star performer too. Imagine your friends' surprise as he reaches for a bottle of fine Scotch with his right arm, grips it, *and neatly pours out the drinks*. Carrying them on his special motorized tray (included), he delivers them to your guests without spilling a drop.

Most robots require detailed computer programming. The joy of Omnibot's *built-in* brain is that he responds to your commands without any complicated or expensive accessories. You simply record his program onto a standard cassette tape. He can even execute his instructions *in your absence*—any time and day you specify within a seven-day cycle.

Omnibot also responds to you instantly via remote control console (built-in microphone even lets you talk over his on-board speaker). Use the joystick to send your helper anywhere in the house. Remote control also turns on his cassette—so he can sing your favorite aria, strobe synchronized eyes flashing.

Glides quietly in two speeds, propelled by two high-torque motors. Comes with instructions, built-in 6v rechargeable battery and recharging unit. Remote control and LCD take six AA batteries (not included). 26H × 15W × 14D", 26 lbs. 90-day warranty.

With his new articulated arm and flexible wrist, Omnibot is even more versatile.

Open your door to Omnibot. And in glides a tireless host, and winning companion for the whole family.

- **Omnibot 2000 #NTM200 $499 (14.50)**

BIONAIRE
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GTA
heater/fan
GYRO TWIN AIRE

The quietest fan—now with heater.

Bionaire's new Mistral™ Gyro Twin Aire combines a powerful 3-speed breezebox fan with a thermostatically controlled heater. To keep you comfortable all year round.

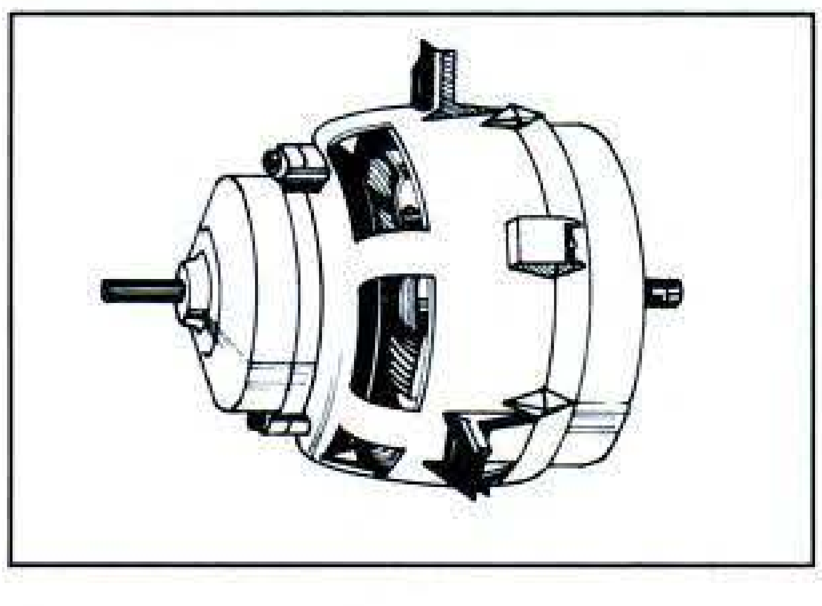
Only Bionaire has a patented louvered grill that slowly revolves—circulating warm or cool air to *all* parts of the room. For concentrated heating or cooling, you can lock the grill in any position. Pushbuttons give you the choice of 750 watts or 1500 watts of warming power.

Unlike the cheap, off-the-shelf motors used in most heaters, Bionaire's rugged motor is specifically engineered for quiet operation. You can set the thermostat to take the early morning chill off your bedroom—without being awakened by a noisy, rattling fan.

Lightweight (only 8¾ lbs.), with molded handgrip for easy portability. Measures 15½H × 15W × 7½D". Safety grills front and back. Plugs into AC outlet. UL listed. Year warranty.

Since Bionaire lets you turn down your furnace and still stay comfortable, it can pay for itself in energy savings. Order today.

- **Bionaire Gyro Twin Aire #NBB104 $149 (8.00)**



Quiet, smooth-running motor is a heavy-duty design built especially for Bionaire.

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Championship golf at your fingertips.

More than a challenging game of skill, new ProGolf™ can actually sharpen your golfing instincts. As you play its computer-animated 18-hole course—complete with fairway doglegs, water hazards and sand traps—you gain skills in strategy and club selection that can mean lower scores on your favorite course.

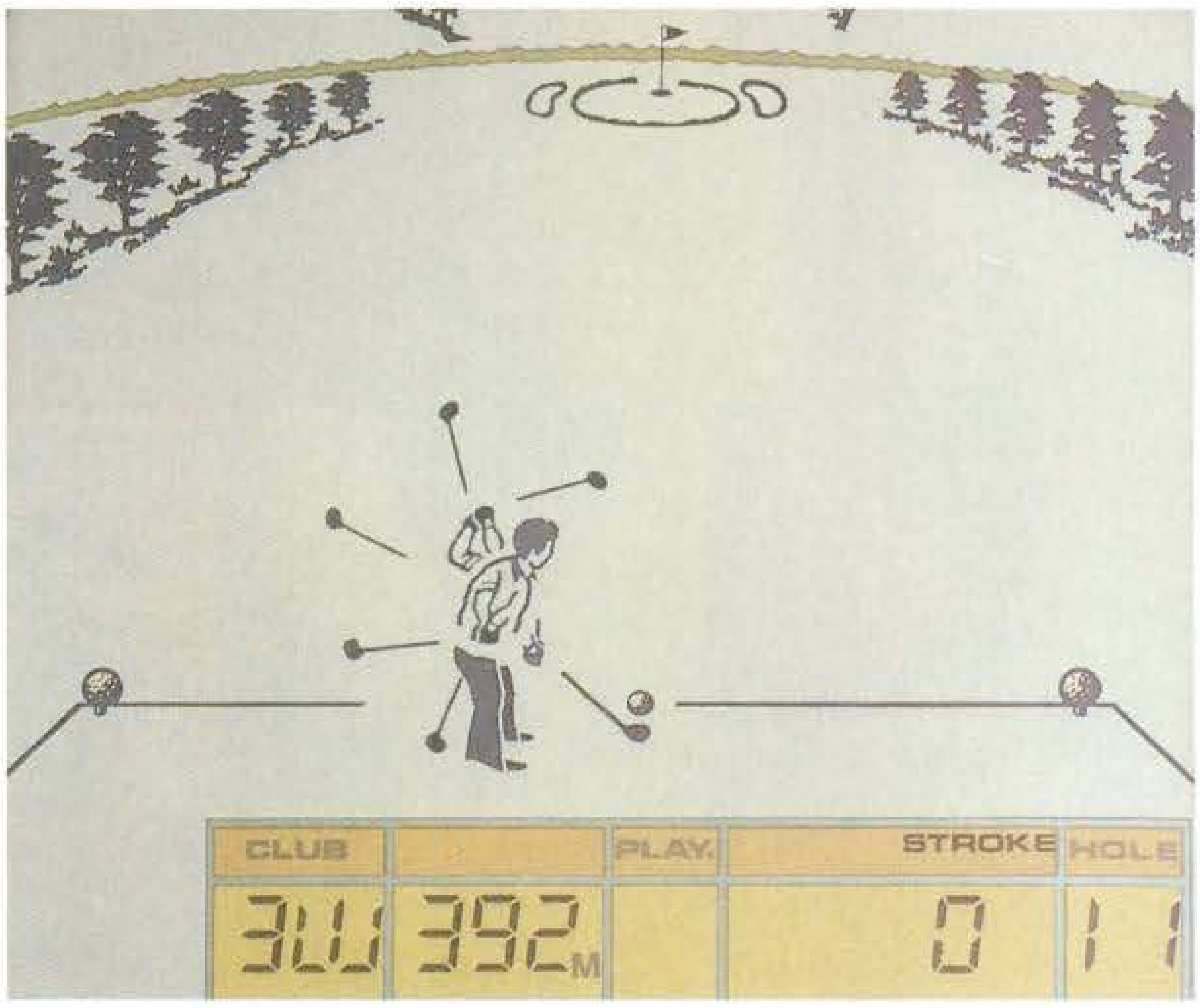
Large liquid crystal screen vividly simulates the terrain and action of real golf. After selecting one of 12 clubs, you press, hold, then release the swing button to determine the force of your drive. On screen, as the moving club nears the ball, you press the button again at the moment of impact. Press too late and you hook. Press too soon and you slice. Realistic sound effects can be turned off if desired.

After each shot or putt, ProGolf displays the distance remaining to the pin. Then the screen changes to show the new position of your ball. Electronic scorecard automatically keeps score for one player, two-player stroke games, and two-player match games. Above the screen, a full color guide shows the length and layout of each hole on the 6200 yard, 72 par course.

In its case, ProGolf measures a pocket-size 7H × 3½W × ¾D", weighs 6 oz. Runs approx. 200 hours on two included calculator batteries. Six-month warranty.

Thunderstorms in the forecast? Dark outside? Now you can enjoy a brisk round of golf anytime, anywhere, in any weather.
- **ProGolf #NBM131 $69 (3.50)**

COURSE GUIDE
ProGolf
ProGolf



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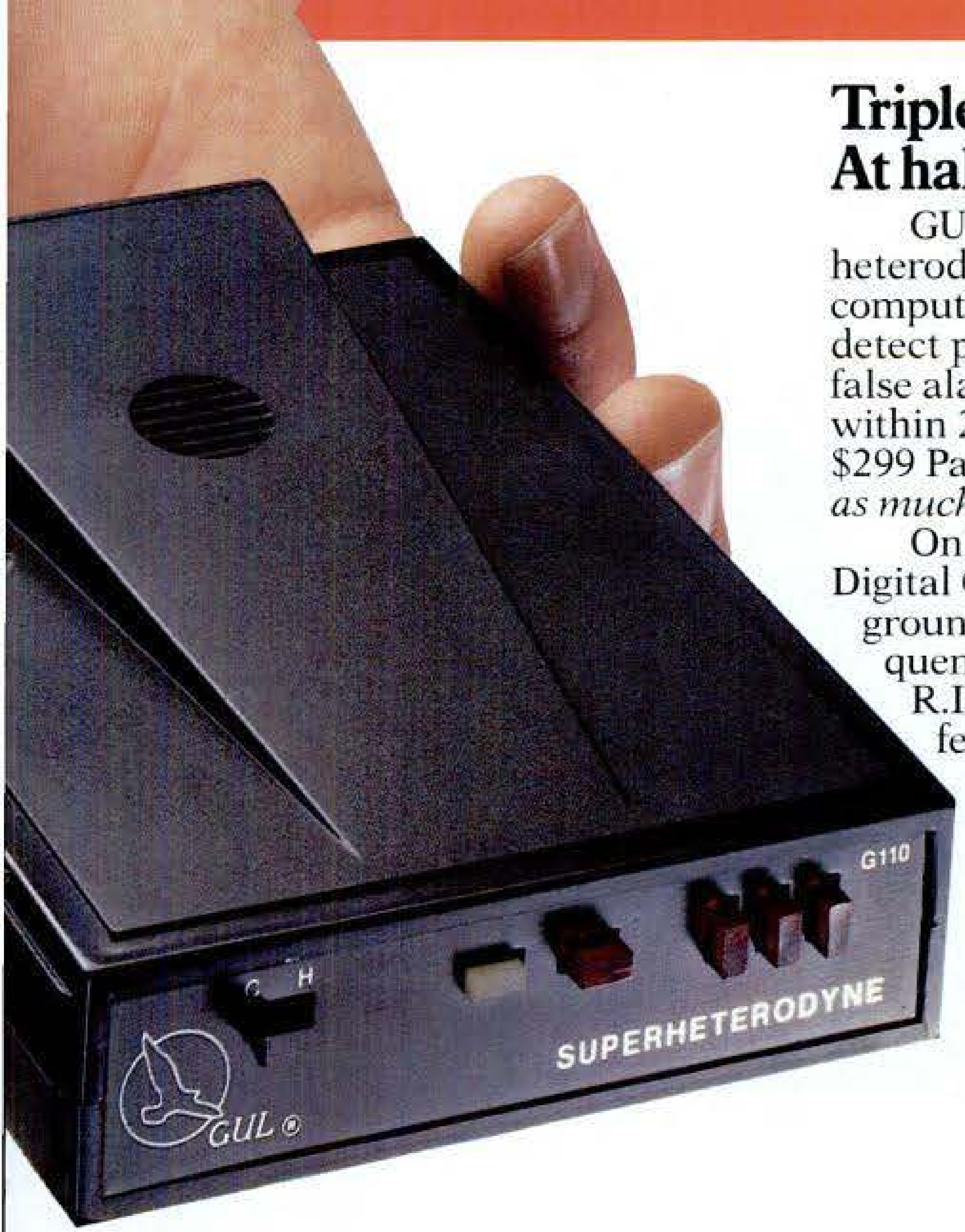
Within two weeks fleas are gone, without poisons, odors, or abrasives. And because the collar is effective within a 4' radius, fleas can't hop back on to nest no matter where your pet roams.

One customer, whose German Shepherd suffered from a serious flea allergy, spent six years and thousands of dollars on vet bills. "As a last ditch effort we purchased your Microtech Flea Collar. Within the first week, all trace of fleas disappeared. We are very grateful to have found something which actually does what it is supposed to do."

Veterinarian-endorsed, *proven 100% safe for dogs, cats, and humans.* Adjustable web collar with LED fits dog or cat. Comes with two Duracell batteries good for approximately six months. Smaller collar measures 18", larger 24".

Fight fleas scientifically—order the Microtech Flea Collar today.
- **Microtech Flea Collar #NBY589 $59 (3.50)**

Please specify large or small collar when ordering.



Triple protection against police radar. At half the size—and price.

GUL's newest micro-sized superheterodyne has the most sophisticated computerized circuitry ever devised to detect police radar, while screening out false alarms. Its measured sensitivity is within 2% of Escort's new micro-sized $299 Passport,™ yet GUL costs only *half as much.*

Only GUL has an Autocorrelator Digital Counter to sweep through background static and find the fixed frequencies of police radar. An exclusive R.I.D.™ (Radar Interference Defeat) circuit eliminates nuisance false alerts caused by other radar detectors. And a City/Hwy. switch adjusts to urban or rural conditions with no reduction in effective sensitivity. Waveguide-type horn antenna pulls in signals from all directions—even on hills and curves.

You're warned in three ways. Red LEDs light up in sequence, then flash as signal strength increases. And you hear a series of beeps (for X band radar) or trills (for K band, which requires your fastest attention). Unlike Escort's warning meter which requires direct eye contact, you can read GUL's flashing LEDs with your peripheral vision. So you can keep your eyes on the road.

Pocket-size ABS case measures 1¼H × 3¼W × 4½D″, weighs 8 oz. Easily concealable, GUL clips onto your visor or attaches to dash with Velcro strip. Eight-foot cord plugs into cigarette lighter. Quality Canadian construction. One-year warranty.

Road test this powerful superhet with your 30-day return privilege—and be protected against speed traps and harassment tickets.

- **GUL Radar Detector**
  #NGU973 $149 (4.50)

Juke box of the 80s. Programmable stereo that plays radio, records, or *seven* cassettes—automatically.

Place seven cassettes in this new Mitsubishi stereo, push a button, and the world's first computer-controlled *cassette auto-changer* gives you 10½ hours of continuous music. Tape reversing is automatic and the computer automatically fast forwards through any blank sections. But that's just the beginning.

Using the simple programming controls, create your own custom concerts. Choose the order of play for cassettes, sides, and individual tunes. (Accepts up to nine instructions.)

This compact, Japanese-built Mitsubishi is a *complete* music system for the serious audio enthusiast. Sensitive AM/FM stereo tuner with edge-lit tuning scale is coupled to a powerful 30 watts per channel (min. RMS at 8 ohms) integrated amplifier with no more than 0.5% total harmonic distortion. Two-way bass reflex speaker systems have 8″ woofers and 2″ tweeters, producing sparkling highs underpinned by a deep, firm bass.

Fully automatic, belt-drive turntable tracks *straight across* the disc for lowest distortion. Quality VM magnetic cartridge. You can program the turntable to play the tunes on an album in any order. *Synchronized recording* lets you make studio-quality tapes.

Mitsubishi sets the record size and turntable speed for you, controls the cassette recording level, automatically selects tape bias (metal, CrO_2, normal). Even gives you a 10-second sampling of every track on a cassette or album.

Cassette console measures 6¾H × 16¾W × 11¾D″ (22 lbs.), turntable: 4H × 16¾W × 12½D″ (13¼ lbs.), speakers: 16¼H × 10W × 7½D″ (11½ lbs. each). Includes jacks for compact disc player, earphones, and sing-along microphone (none included). Comes with speaker wires, AM and FM antennas, 45 RPM adapter and one-year warranty.

- **Mitsubishi Computer Automated Stereo**
  #NMS700 $499 (12.50)

MITSUBISHI
SPEAKER SYSTEM SS-L70

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Marine masterpieces from Heuer.

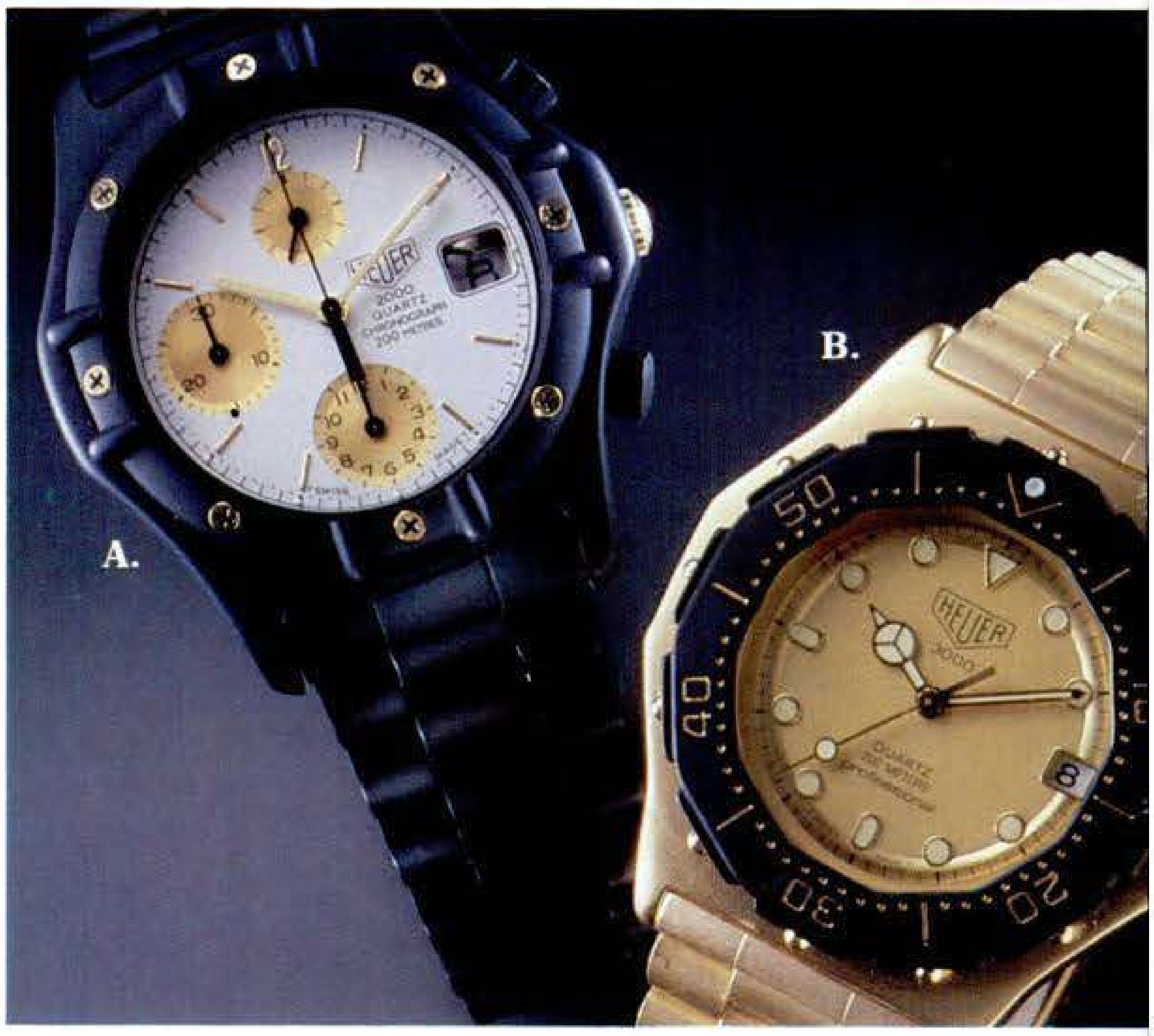
For men and women, Heuer creates the ultimate in luxurious marine timepieces. The rugged cases and bands are machined of solid stainless steel. A special gasket seals the crystals for water resistance to 660 feet. Precision Heuer quartz movements with ± 10 seconds per month accuracy. Luminescent hands, sweep second hand, and calendar window. Each comes with 2 year battery and gift case. Year limited warranty.

A. The world's first Swiss analog quartz chronograph. Three inset faces, coated with 15 microns of 18K gold, indicate stopwatch seconds, minutes and hours. Black anodized finish. Mineral glass crystal.

- **Heuer Black & Gold Chronograph**
  (Man's) #NHU253 $675 (6.50)

B. This Golden Diver is coated with 15 microns of 18K gold on the case, dial and bracelet, set off by black anodized timing bezel. Sapphire crystal.

- **Heuer Golden Diver**
  (Man's) #NHU474 $595 (6.50)
  (Woman's) #NHU476 $595 (6.50)



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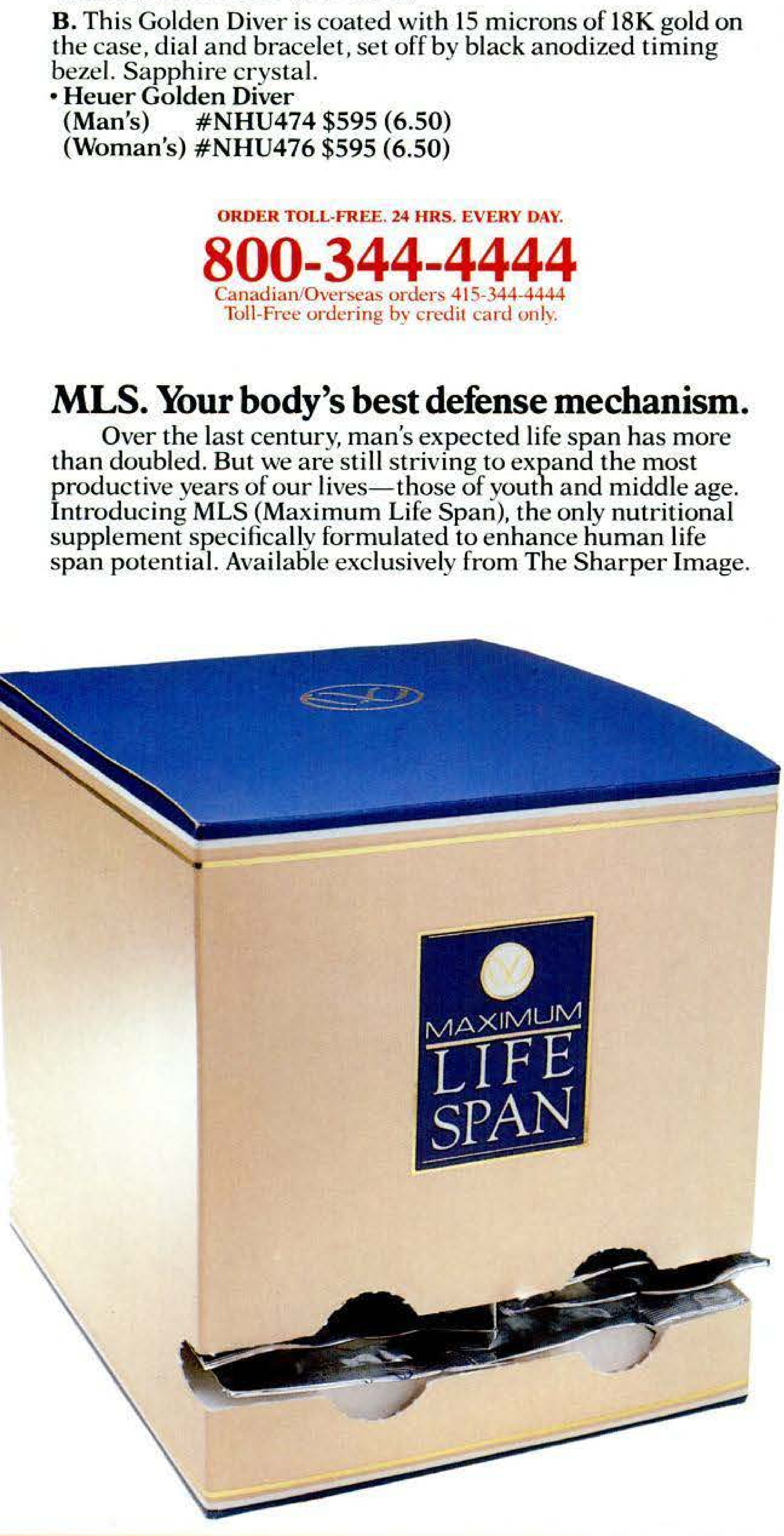
MLS. Your body's best defense mechanism.

Over the last century, man's expected life span has more than doubled. But we are still striving to expand the most productive years of our lives—those of youth and middle age. Introducing MLS (Maximum Life Span), the only nutritional supplement specifically formulated to enhance human life span potential. Available exclusively from The Sharper Image.



MLS supplements take advantage of recent discoveries by gerontologists, which show how substances called *anti-oxidants* may substantially enhance cellular function and protection of the body's vital organs and tissues. Oxidation within the body produces highly-charged "free radicals"—which can attack cell membrane and DNA. When DNA breaks down, the body's ability to make healthy new cells is greatly reduced—what we call aging. MLS's unique formula is the first to combine powerful anti-oxidants, with all the vitamins and minerals essential for healthy bones, teeth, skin, hair, and bodily function. Six tablets taken twice daily include (partial list):

**Enriched Lecithin/PA*. Imported from Germany, this capsule contains the highest possible amount of phosphatidyl choline, plus pantothenic acid—necessary for conversion of choline to brain neurotransmitters.

**Vitamin E*. Shown to lower cholesterol levels, and to help protect the body from highly toxic substances which promote aging.

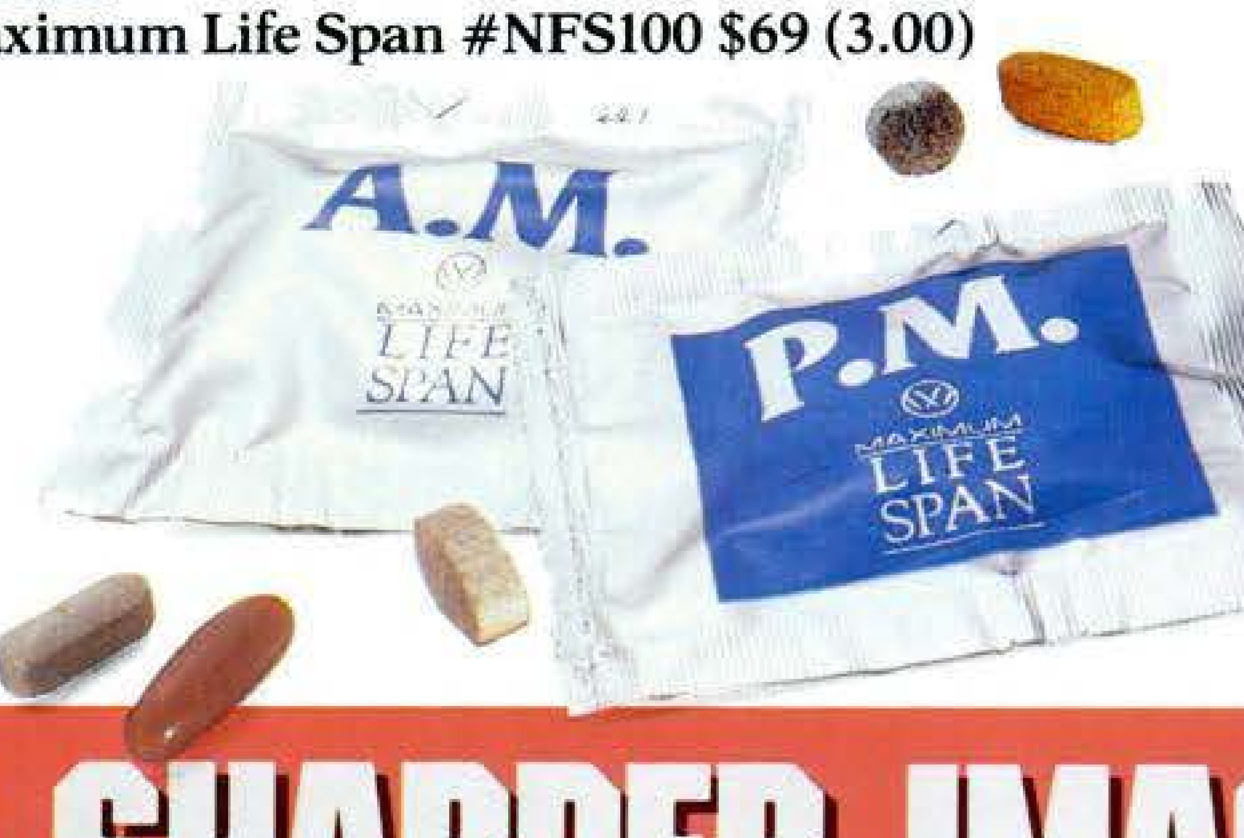
**Bioflavonoid*. A capillary strengthener which protects cells against damage that promotes aging, also helps the body efficiently absorb vitamin C for the greatest possible benefit.

**Cysteine*. A vital amino acid produced by the body which decreases with age. Shown to significantly extend the life span of animals, and to protect them against damage from polluting chemicals.

Each day's supply of tablets is sealed in watertight a.m./p.m. foil packets, for freshness and convenience. Contains no sugar, starch, artificial colors, flavors, or preservatives. Includes a 60-day supply.

There is no cure for aging. But as science begins to understand the cellular changes that occur with time, the alteration of the basic process of aging has become a reality. Order MLS today, and begin to add years to the best part of your life.

- **Maximum Life Span #NFS100 $69 (3.00)**



Software that uncovers your sexual self.

Years of our lives are spent thinking about it, dreaming about it, pursuing it—and doing it. Now a sophisticated software program puts all the most recent scientific discoveries about sex *right into your computer*. Introducing IntraCourse,™ the first software that reveals your personal sexual profile, and improves marital compatibility.

IntraCourse asks you from 85–145 deep and probing questions about relationships, fantasies, sexual behavior, and specific preferences. As all responses are coded, you are guaranteed total confidentiality.

Next, IntraCourse uses a million bytes of logic to process your answers into an in-depth, 3–12 page analysis: your sexual profile. Describing areas like sexual creativity, intimacy, where you fit in the hetero/homosexual continuum, and analyzing your practices and fantasies in the context of the general population. All backed up with dozens of fascinating statistics. Unlike superficial magazine questionnaires, IntraCourse is frank, detailed, and based on up-to-date studies in human sexuality—including Kinsey, Masters and Johnson, and more than 100 other sources.

Equally valuable when used with a partner, IntraCourse's Compatibility Menu measures compatibility in 12 diverse categories. Discover fantasies, desires, and preferences you share—or don't share. As you become more adventurous and creative, with new desires (and/or partners), you will find IntraCourse an on-going, invaluable gauge of your sexual self.

Includes on-line dictionary, and provides footnotes which link you to titles of additional reference materials.

Order this educational—and entertaining—software today. And discover possibilities for pleasure far beyond your former expectations.

- **IntraCourse #NIC704 $99 (3.00)**

No returns on software once package is opened.
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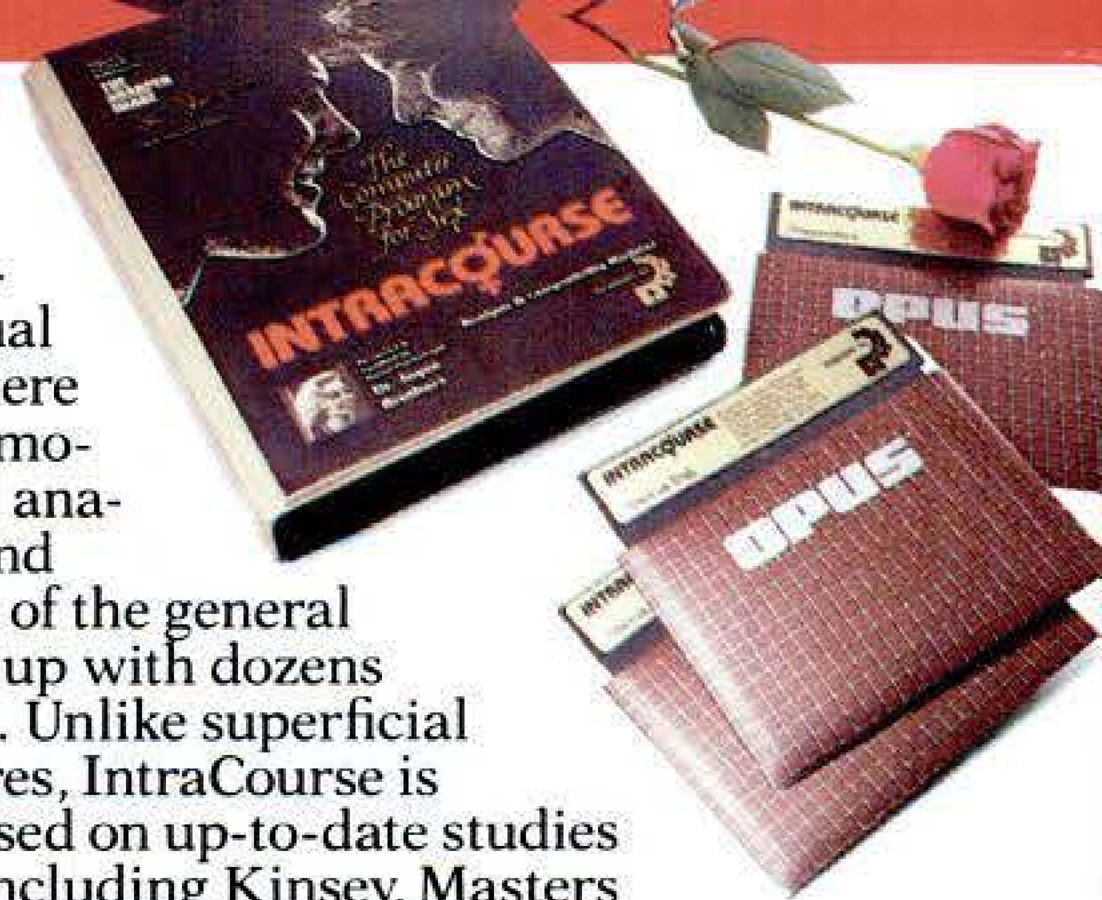

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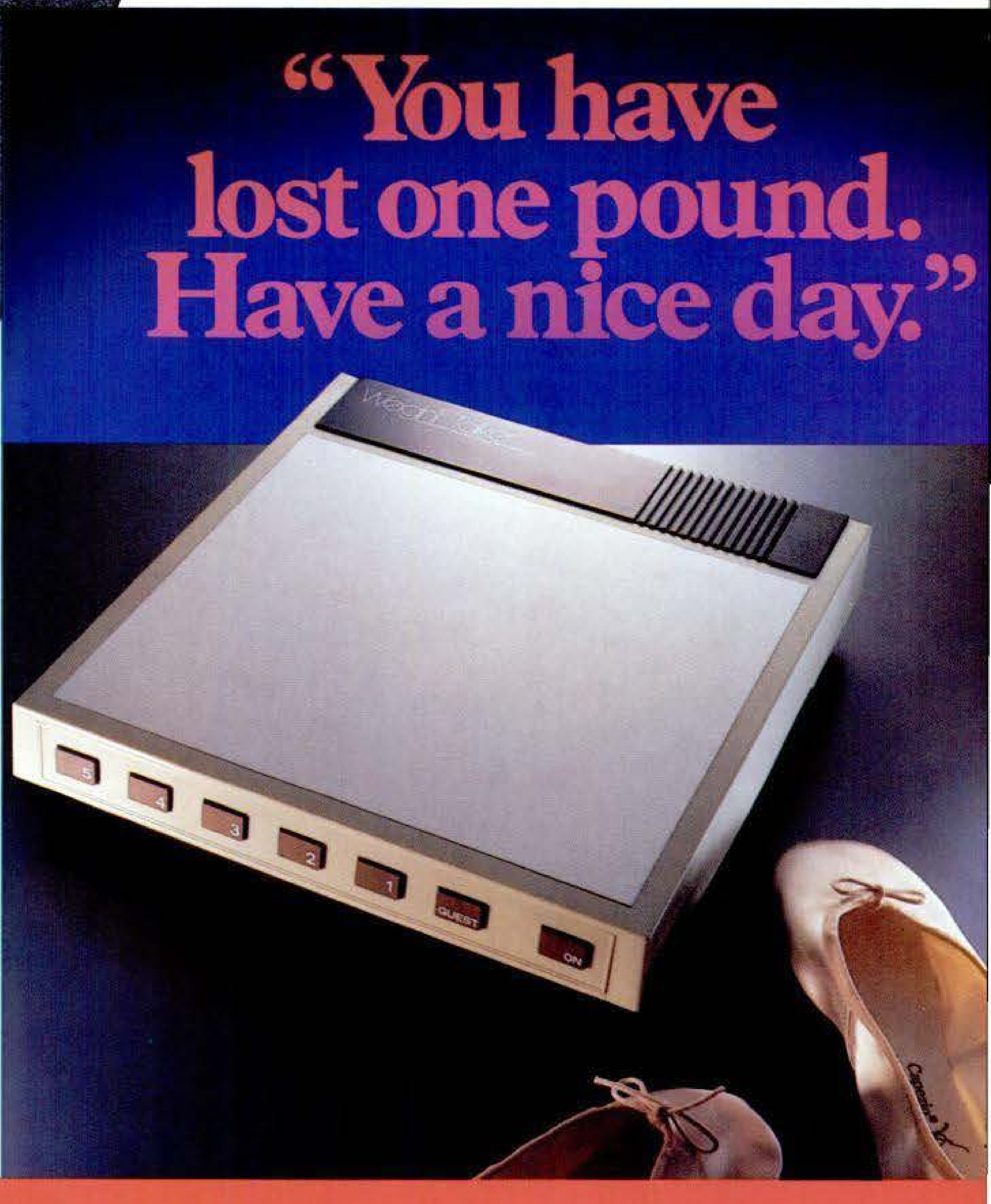


Bathroom scale with a voice.

Imagine the surprise and delight of your guests when they encounter Weight Talker™, the new electronic scale with a friendly synthesized voice. Never again will you have to stoop or squint to read your weight. Now you'll hear it spoken, in a pleasant male voice. (Adjustable volume for privacy.)

Weight Talker remembers weights for up to five family members and tells you to the pound (or ½ kilogram) how much you've lost or gained. Oversize rubber On button and memory keys operate at the press of your toe. Other controls include kg/lb. switch, memory On/Off, "Have a nice day" or "Good-bye" phrase switch.

The sophisticated electronics are housed in a strong steel base and rugged ABS outer shell. Weighs up to 287 lbs. (130½ kg). Runs on seven AA batteries (not included). Auto Off saves power. Measures 3H × 14W × 13D", weighs 8 lbs. Comes with instructions and one-year warranty.

Replace your old scale with Weight Talker, and now when you stick to your diet, you'll hear the good news every morning.

- **Weight Talker #NTZ357 Was $129. Now $99 (5.50)**

In The Sharper Image stores, it's the people who make the difference.

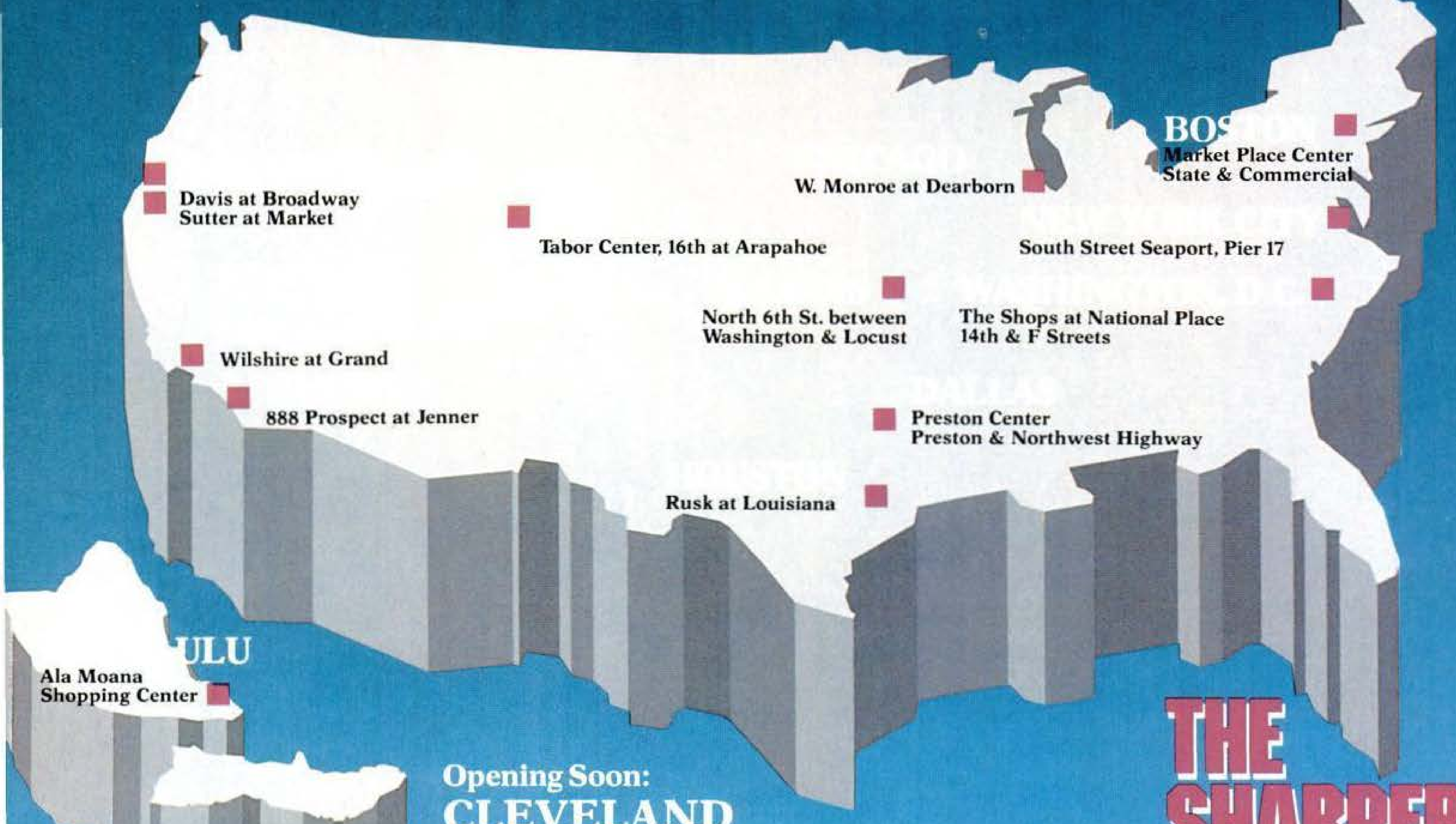
"Robert Hassold's knowledge of your merchandise and his courtesy in working with customers is commendable...He and your store are a good addition to New York."
—B.W.B., New York, NY

"Ray Burns of your Houston store is to be commended for his honesty, his willingness to serve his customers, and to see that each of us was satisfied with our purchase. Thank you Ray Burns. And thank you, The Sharper Image!"
—S.Z. and N.C., Houston, TX

"Mr. Brad Lyon of your new store in Washington, DC, is the most helpful salesperson I have ever dealt with in retail sales..."
—D.T., Arlington, VA

"Recently...I discovered something which I had thought was all but extinct; a courteous and truly helpful salesperson...Dealing with The Sharper Image, and in particular Mr. Wally Stark, was a very enjoyable experience, which sadly is not very common these days..."
—R.G., Bronx, NY

Visit our stores.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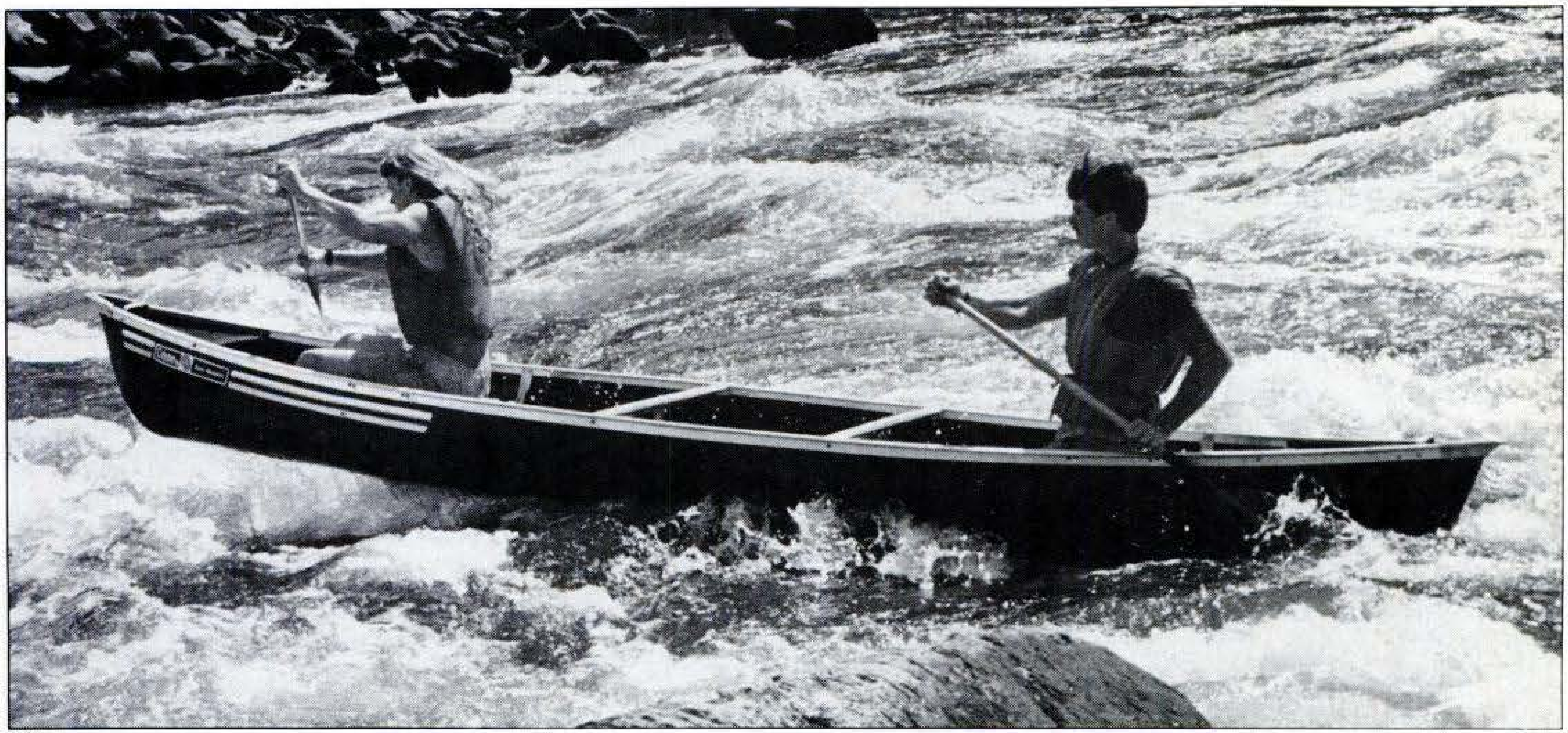
What's New
in Recreation

BY STUART F. BROWN

Bugless and roomy

Sleep side by side under the stars without battling the maddened mosquitoes, promise the makers of Sleepscreen II (Epco Design, 900 First Ave. S., Seattle, Wash. 98134). The new $30 twin version weighs only 23 oz.

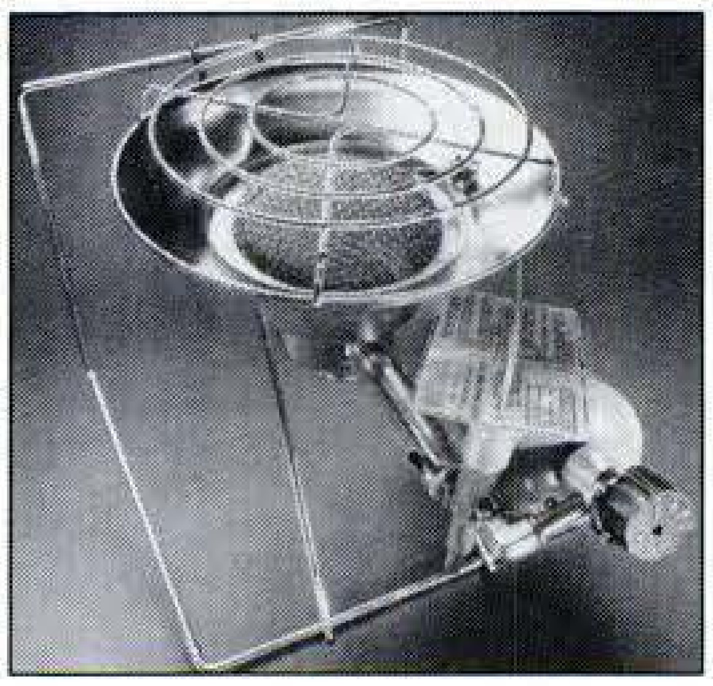


Replaceable keel

If the keel of Coleman's 16-ft. Gold Medalist canoe is damaged, a new one can be installed. The 79-lb. molded polyethylene boat was tested by the U.S. white-water canoeing team. Price: $450. Coleman Co., 250 N. St. Francis, Wichita, Kan. 67201.

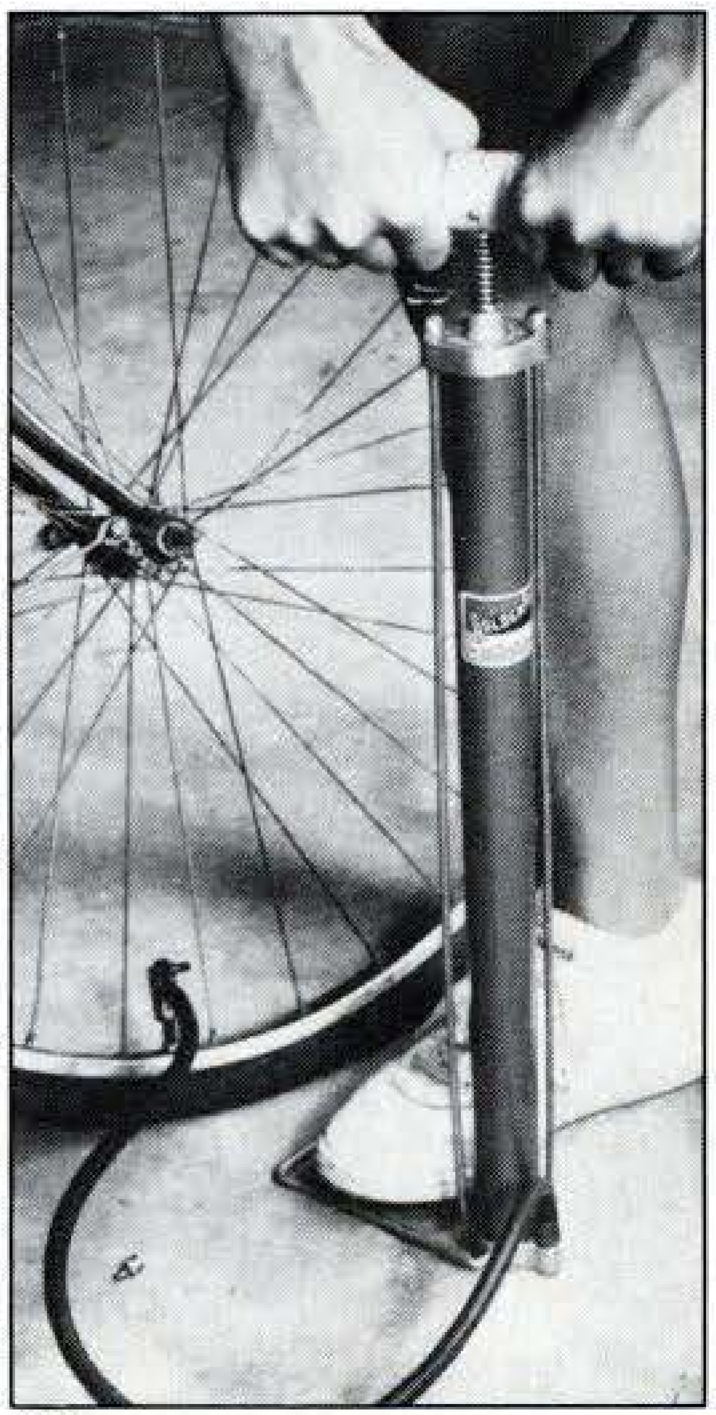
Heater/stove

Standing upright, it's a radiant heater that will put out up to 12,000 Btu/h. When placed on its side, it's a portable cooker. Mr. Heater-Cooker, from Enerco (Box 6660, Cleveland, Ohio 44101), is fueled by a propane cylinder. Price? $72.



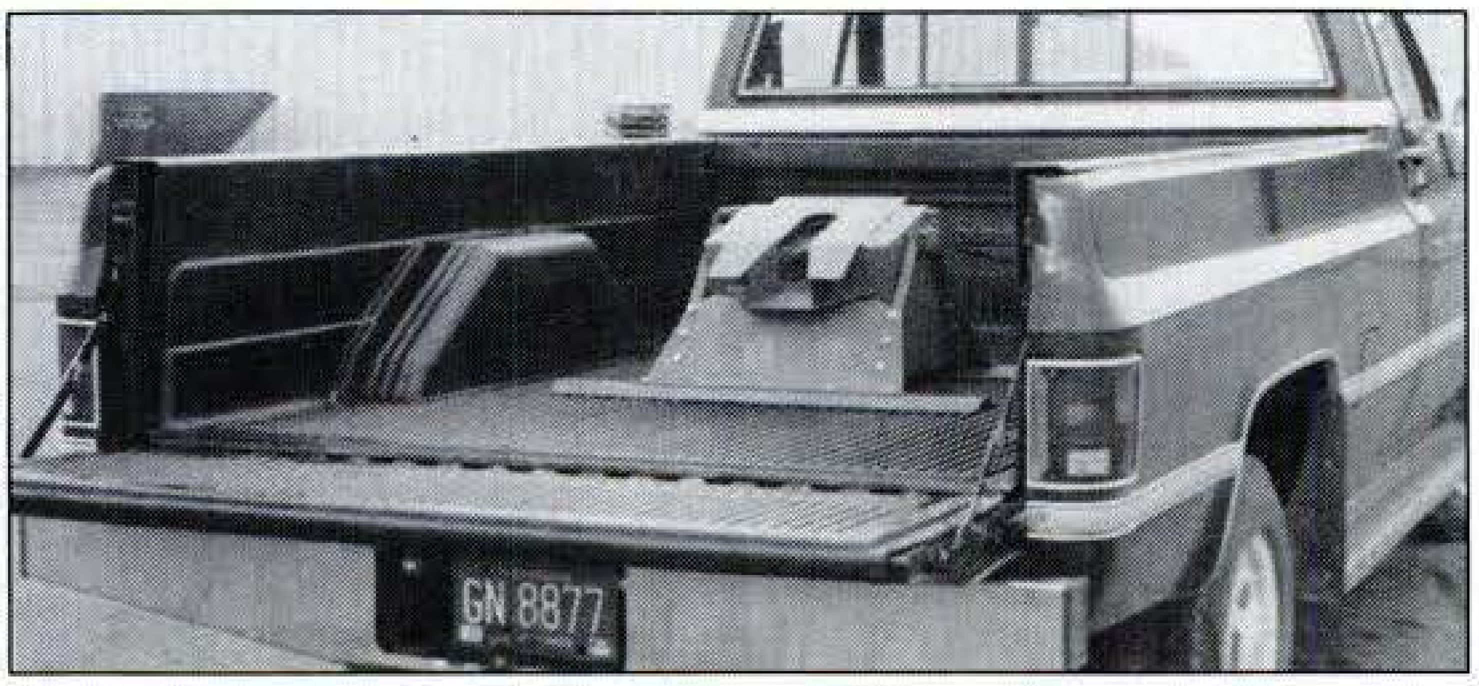
Character boat

Work it as a tug, or cruise it as a motor yacht; the 38-ft. American Tug-Yacht plows on at eight knots, powered by a 100-hp Westerbeke six-cylinder diesel engine. Base price: $148,000. Cape-Bay Shipbuilders Corp., Marion Dr., Kingston, Mass. 02364.



One size tows all

Any domestic or foreign pickup truck can do fifth-wheel trailer-hauling duty with this universal hitch, claims Owens Classic (Box 628, Sturgis, Mich. 49091). The 80-lb. unit is completely removable when not in use. It costs $380.



Relentless pressure

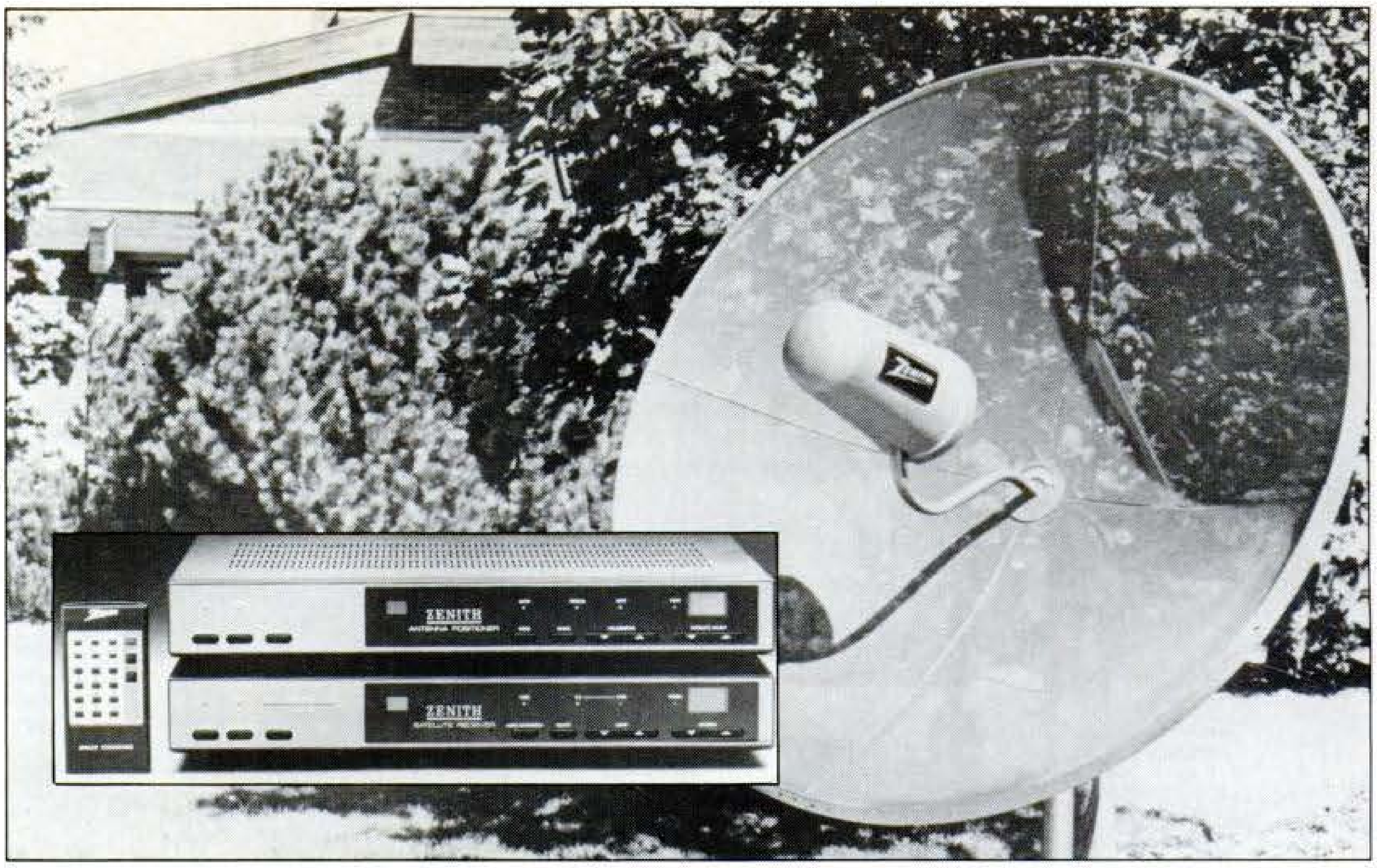
Heavy construction makes the Golden Rod pump a survivor, says Dutton-Lainson Co. (Box 729, Hastings, Neb. 68901). Claimed output is 200 lbs., more than enough for inflating bicycle tires or topping-up automobile tires. Suggested price is $16.30.

What's New *in Electronics*

BY WILLIAM J. HAWKINS

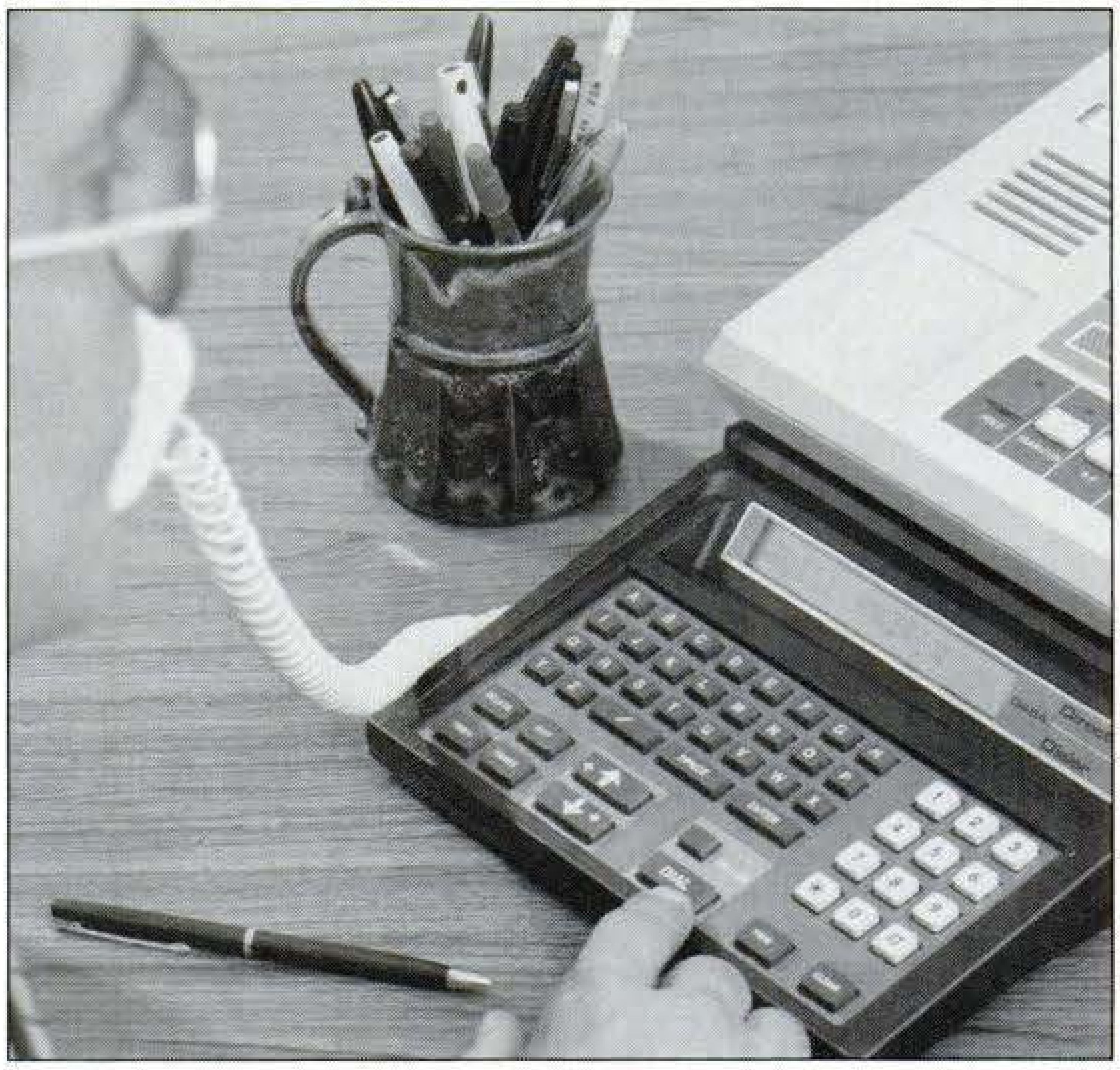
Quicker picker

This satellite receiver and antenna positioner (inset) can be programmed for instant selection of up to 24 channels on 24 different satellites via the remote control. The Zenith system, including the motorized 10-ft. dish with low-noise block downconverter, is $2,549.



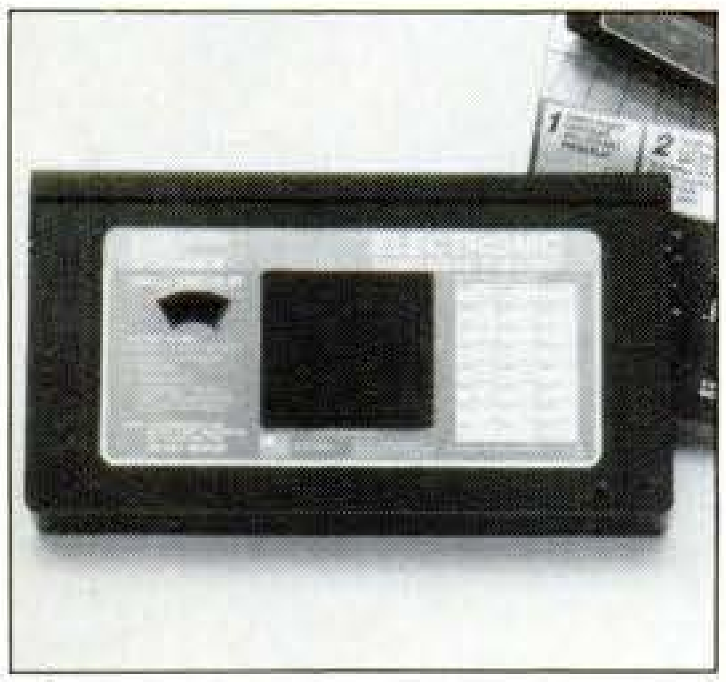
Personal directory

Type the first letters of a name on the keyboard. The Directory Dialer dials the phone number, then displays information like title, company, and address. Up to 800 250-character entries can be stored. Made by Dasa (91 Montvale Ave., Stoneham, Mass. 02180), it's $495.



Car-less phone

What don't you need for Radio Shack's cellular car telephone? A car. The unit slips from its mobile mount and combines with a battery pack to become an 11-lb. on-the-go communications system. The phone is $1,199; battery pack, charger, and antenna are $120.

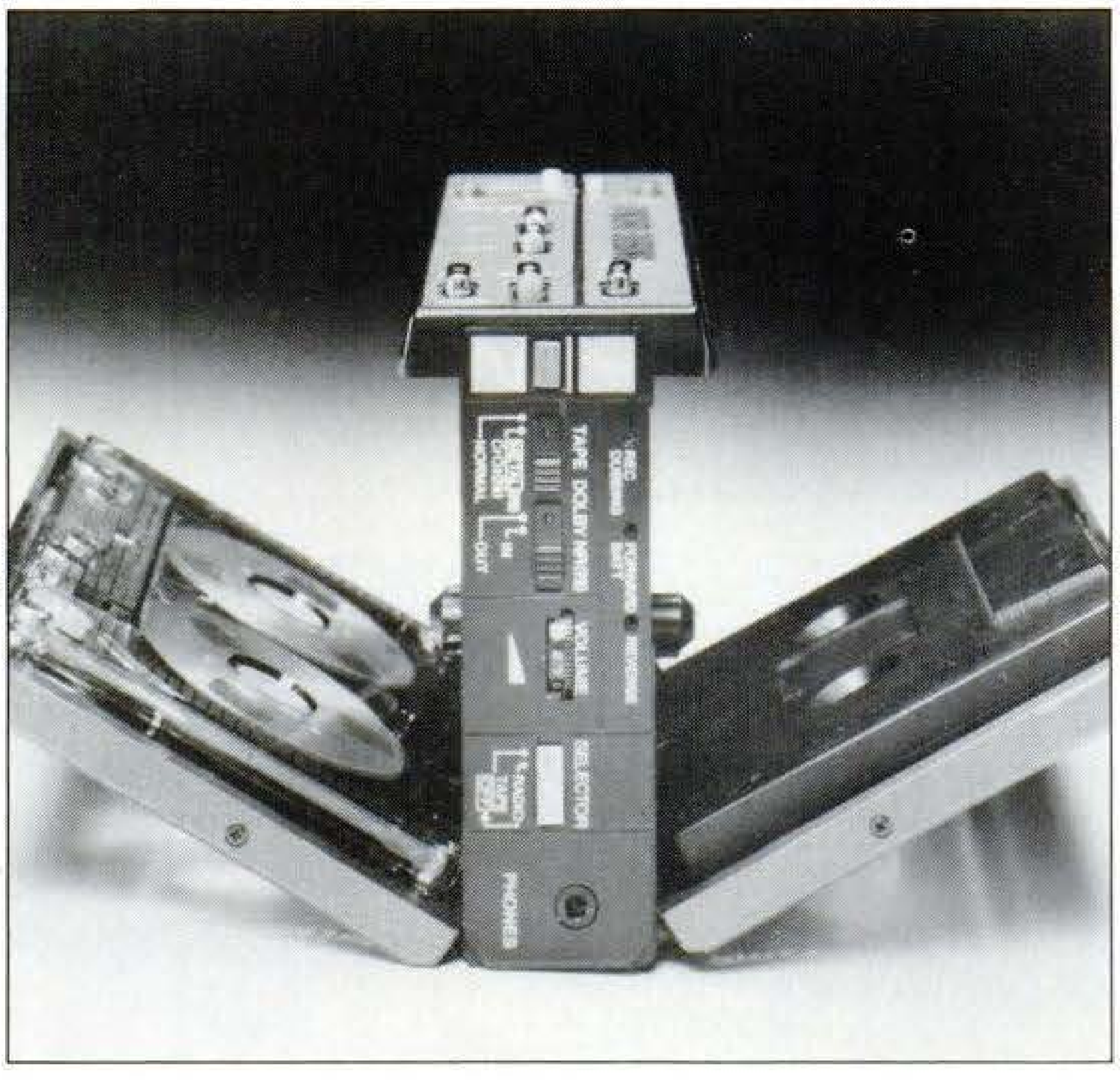


Smart VCR cleaner

No more guesswork: A microprocessor inside Video Dynamics' (6525 Oxford St., St. Louis Park, Minn. 55426) VCR cleaning cartridge dispenses the proper amount of fluid and calculates how much time is needed to clean tape paths and heads. A tone sounds when it's done. $25.

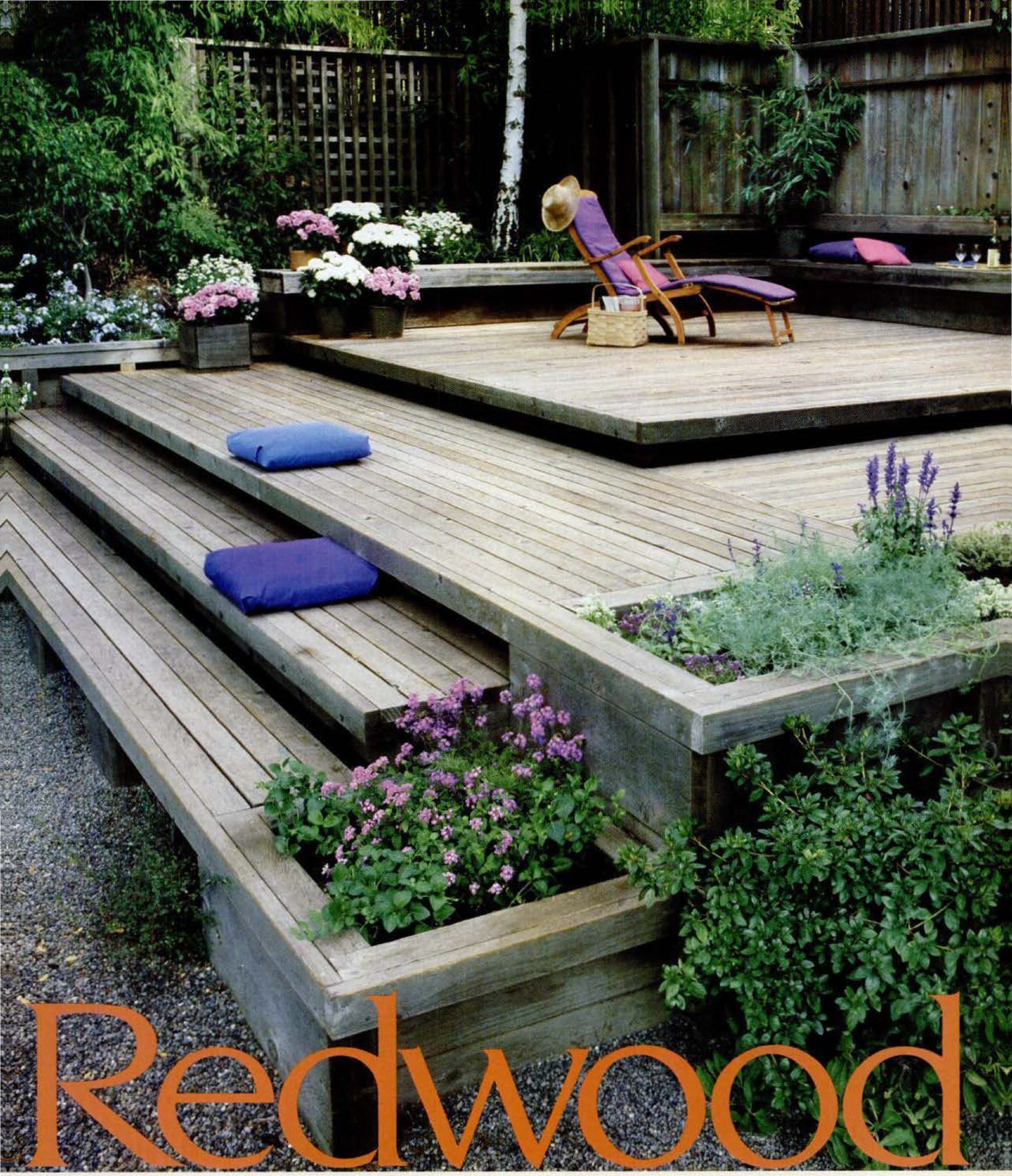
Dual cassette

It's an AM-FM stereo personal radio, and it's a dual-cassette recorder, too. Panasonic's RX-HD10 has front and back decks that let you record from the tuner or dub one tape to another. In play mode, the unit automatically switches decks for continuous music. Price: $200.



Home protector

Tiny transmitters monitor all areas of your home. When there's a problem—like a break-in or medical emergency—Keepsafer signals the receiver, and a coded alarm alerts you to the trouble and cause. Made by Schlage (Box 3324, San Francisco, Calif. 94119), it's $179.



After 15 years – no warping, no splitting, no refinishing; not even a board replaced. And it will last for years more. That's the beauty of redwood. Send 50¢ for deck booklet.

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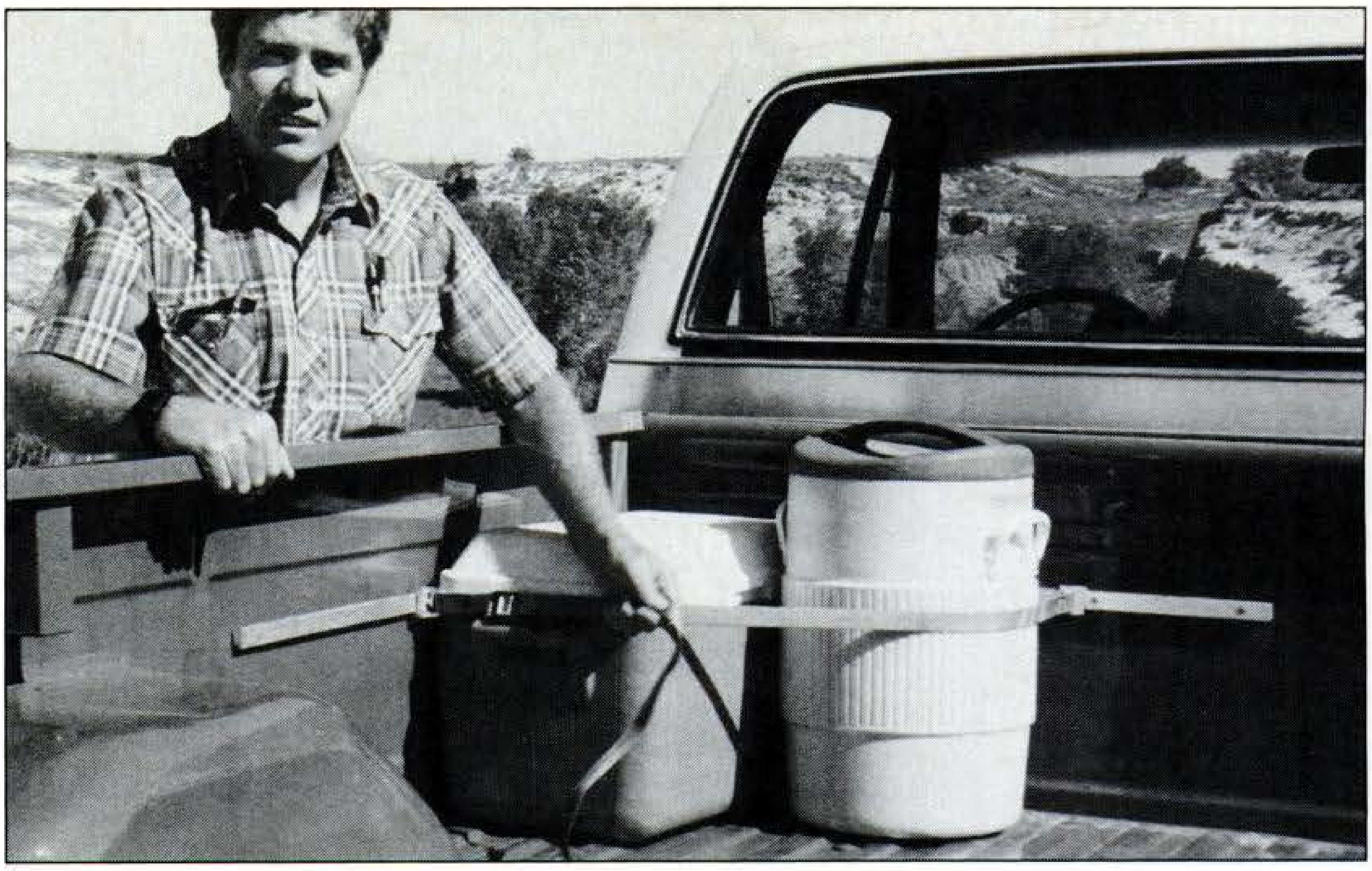
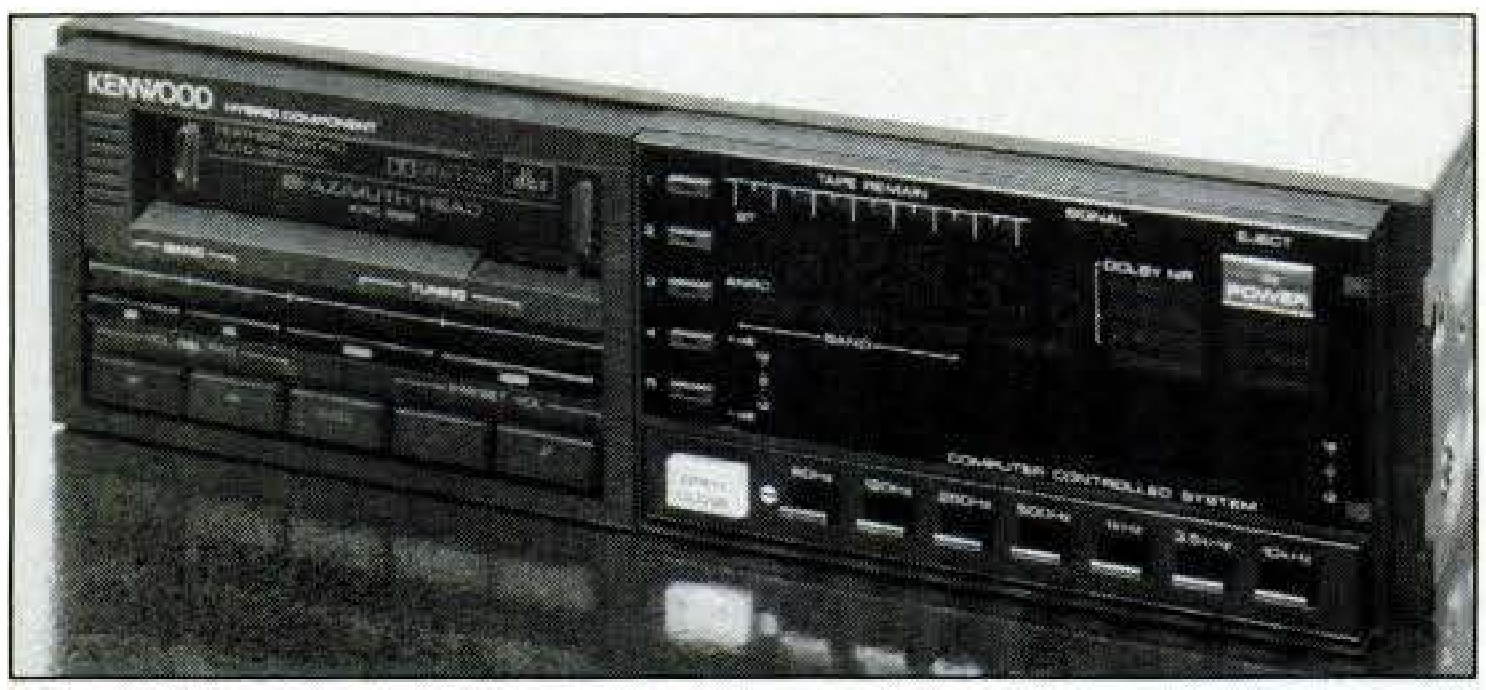
What's New
for Your Car

BY JACK KEEBLER



Cargo restraint

Loose cargo can be damaged or cause an accident by flying out of a truck bed. Cinch-It (1354 N. Chicago, Portales, N.M. 88130) says its restraint system will secure objects 6 in. to 3 ft. in diameter, and that you can install the $50 system with a screwdriver in less than 15 min.

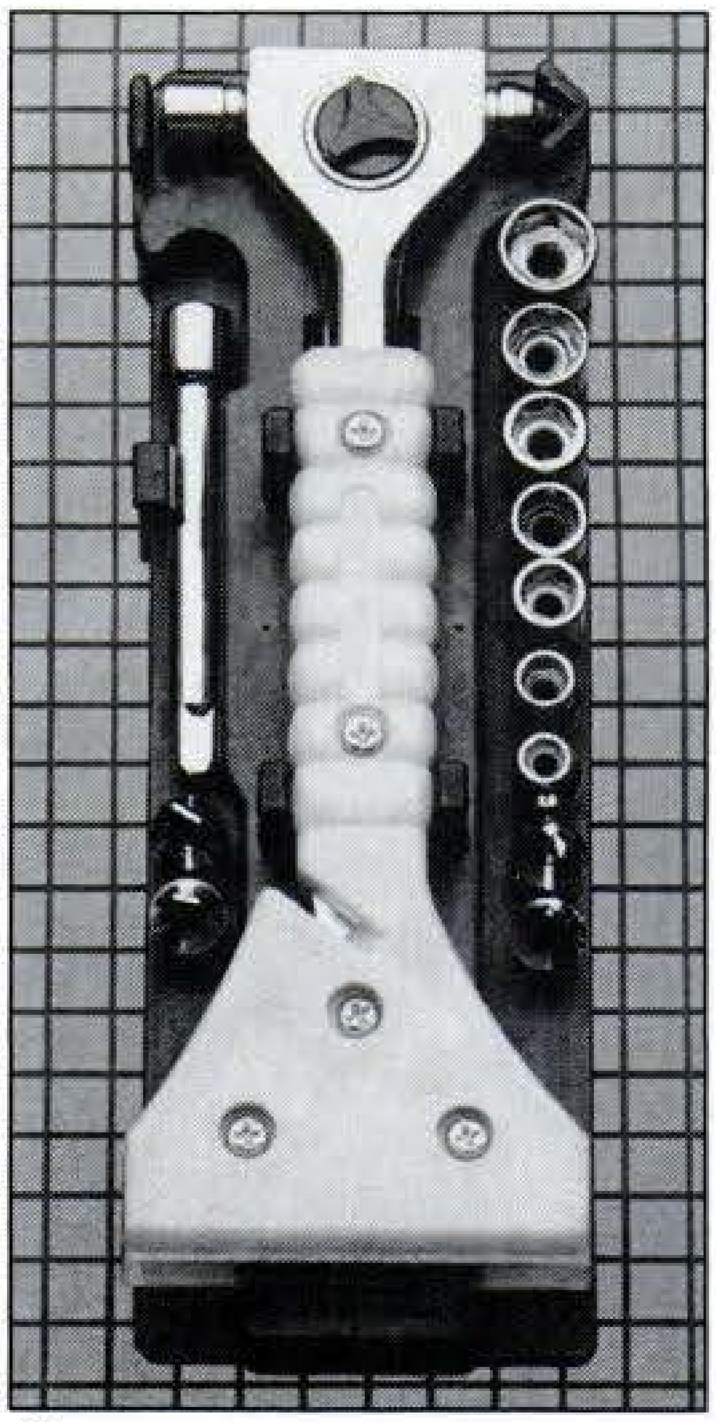


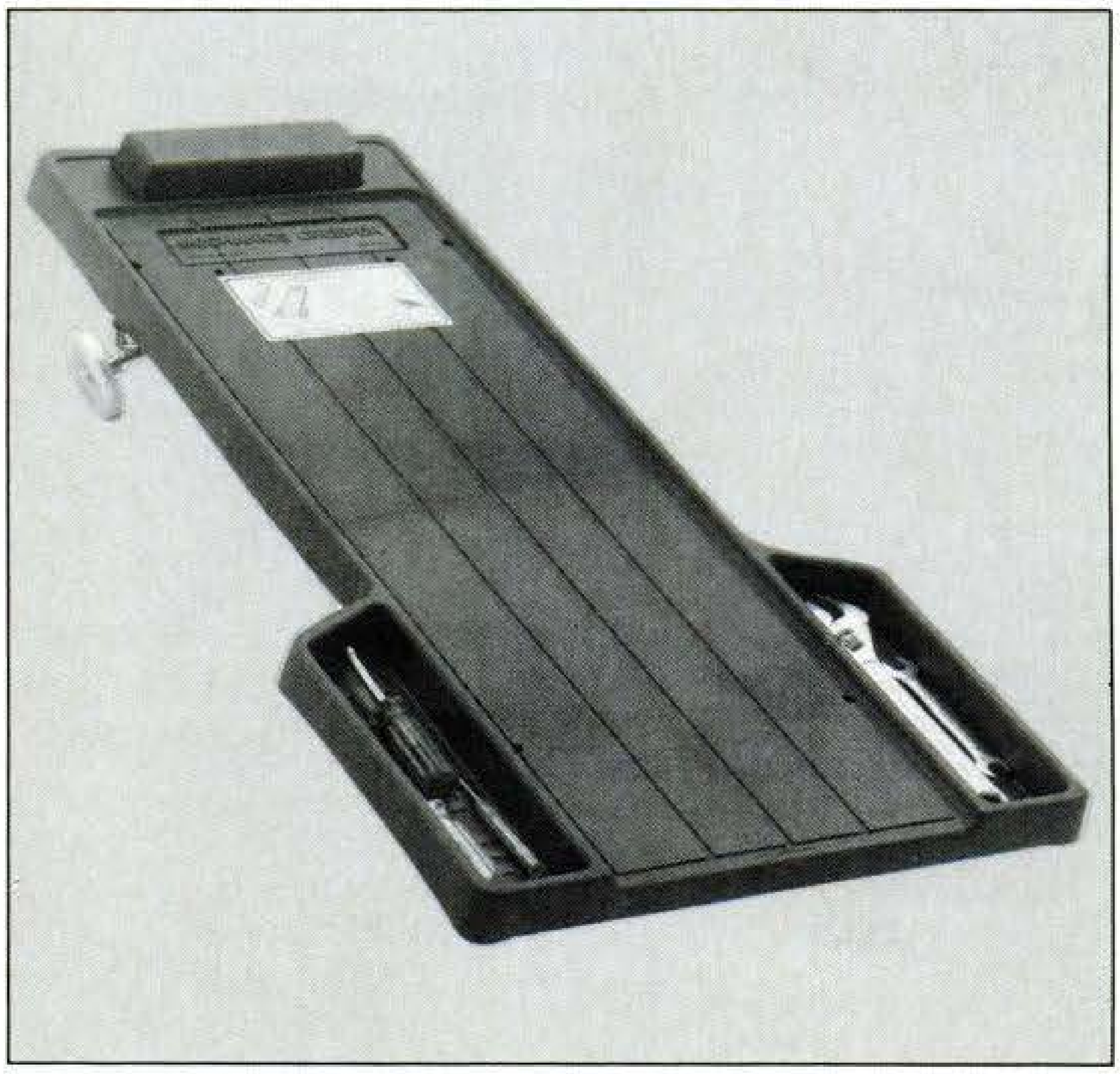
Smart tuner

Kenwood combines a tuner, cassette deck, and graphic equalizer in the computerized KRC-999. Dolby B/C and dbx noise reduction, blank-tape skip, index scan, and memory for balance, fader, tuner, and graphic equalizer are just some of 999's features. Price: $1,400.

No-hands phone

Clip Audiovox's small, wired HF-50 microphone to the sun visor, steering wheel, or your lapel, and talk hands-free on the $1,995 CMT-500 cellular telephone. You hear the other party's voice through a separate speaker in the CMT-500's cradle. The HF-50 microphone costs $200.





Plastic creeper

Even the biggest mechanics will be comfortable on the Kangaroo Creeper, thanks to its built-in headrest and 450-lb. capacity, claims Koller-Craft (1400 S. Highway 141, Fenton, Mo. 63026). Made of polypropylene, the $17 creeper has two large pockets for parts and tools.

Car tool

Rescue Rachet tightens loose screws, nuts, and bolts; scrapes icy windshields; cuts seat belts; and can even be used to break jammed windows, says JRJ Industries (4617-B S. Buckner Blvd., Dallas, Texas 75227). The tool mounts in your car so it's always at hand. $17.90.

No-weld patch

Dimple the metal around a repair with Hide A Screw, drill a hole in each dimple, and attach a metal patch behind the panel with screws inserted in the dimples. After filling and sanding, the fix is body-flush. West River Industries, 3514 Palmer Dr., Cleveland, Ohio 44116; $9.70.

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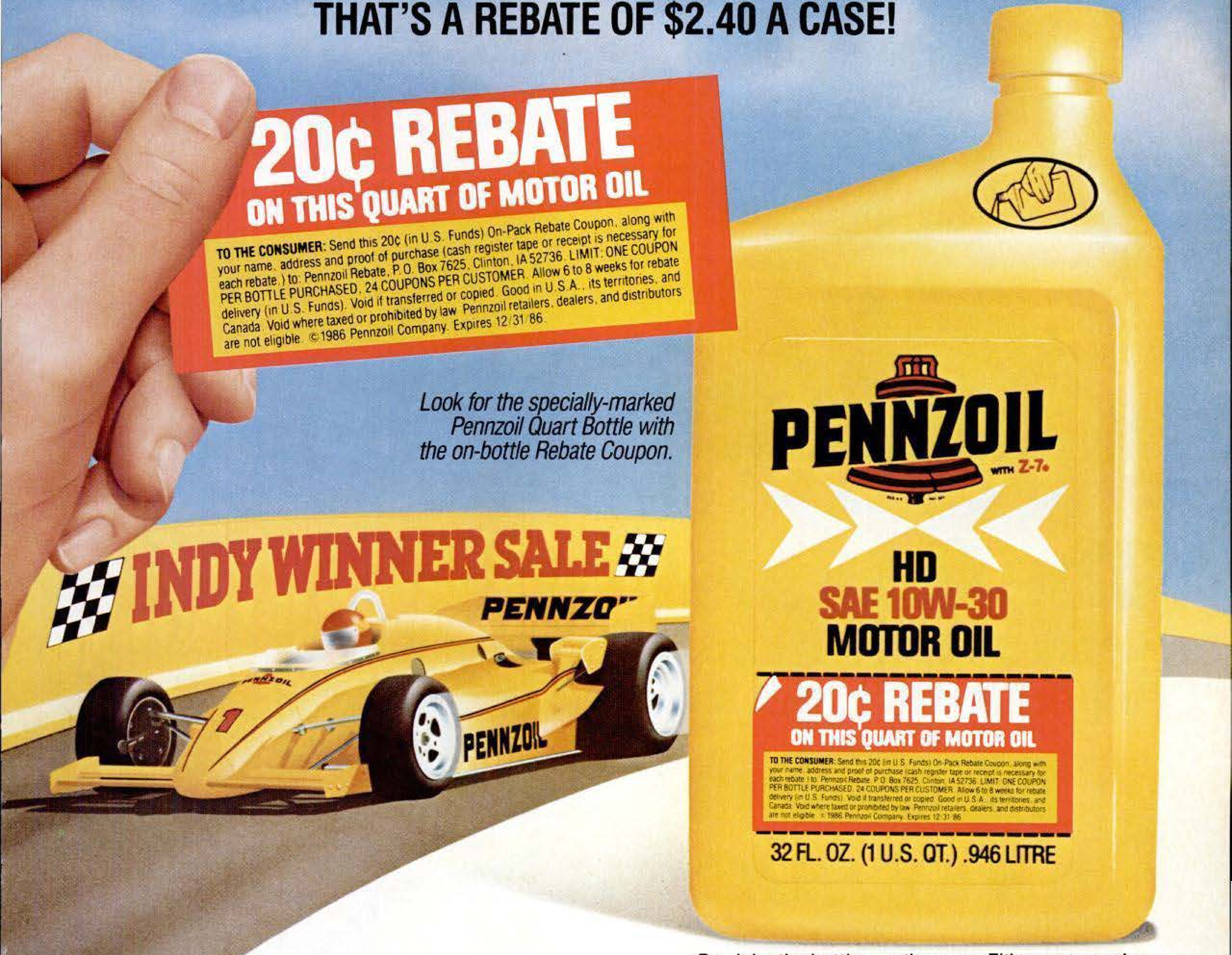
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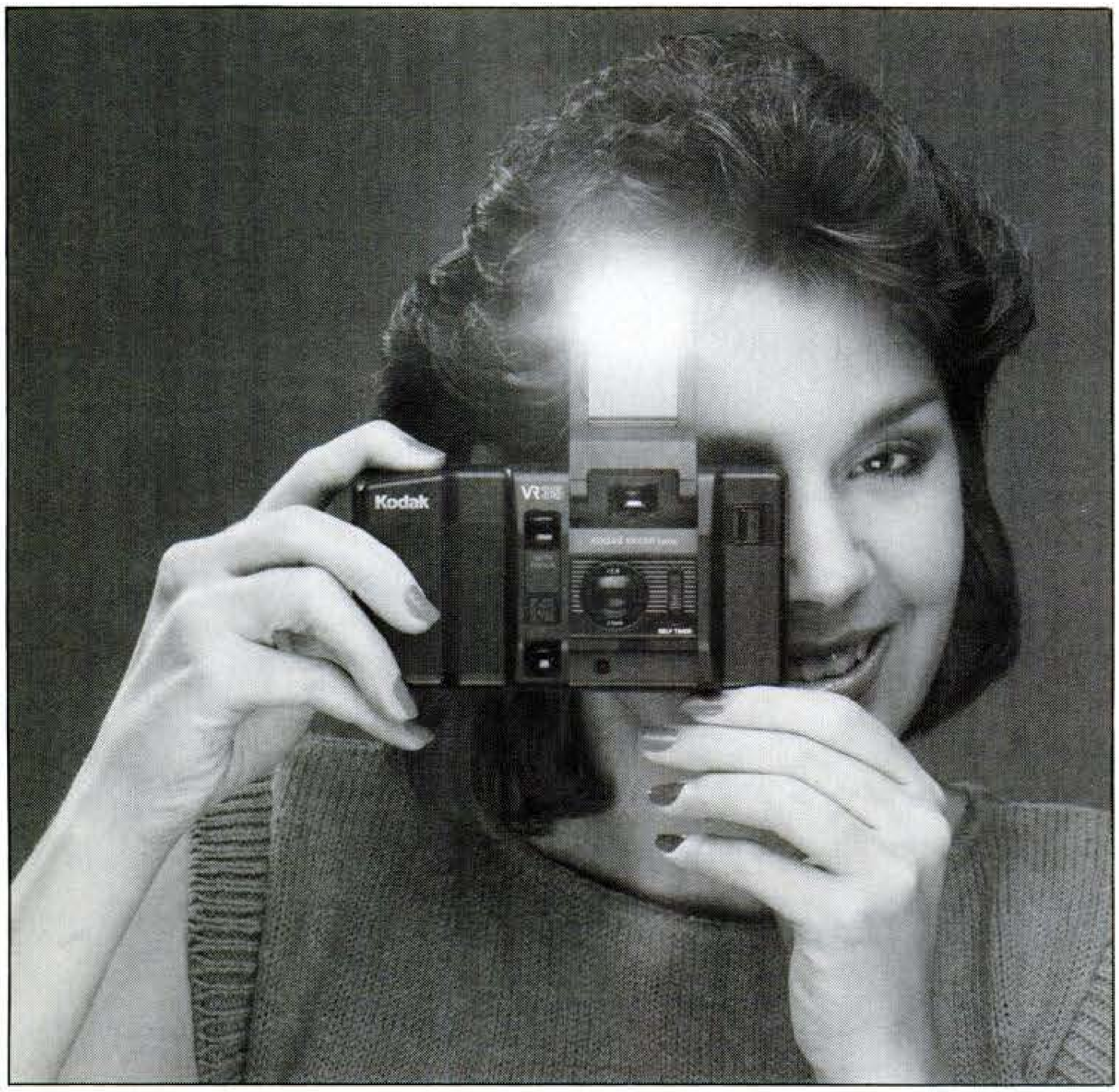

Flip-flash

By ARTHUR FISHER

After an absence of some 15 years, Eastman Kodak Co. has entered the 35-mm fray with two autofocus cameras, the Kodak VR 35, models K12 and K10. Both cameras are manufactured by Chinon Industries of Japan but were principally designed by Kodak engineers.

The K12 is the camera shown in the photo and phantom drawing. It is the more capable of the two, and, naturally, the more expensive. It lists for \$200; the K10, for \$130.

Both models have automatic film-speed setting, automatic exposure, and autofocusing. And they share a clever and appealing flash system built into a flip-up cover, which protects the lens when closed. Opening the cover energizes the camera and flips the flash into position a few inches above the lens, as you can see in the photo. Keeping the flash off the lens axis helps avoid the dreaded red-eye effect.

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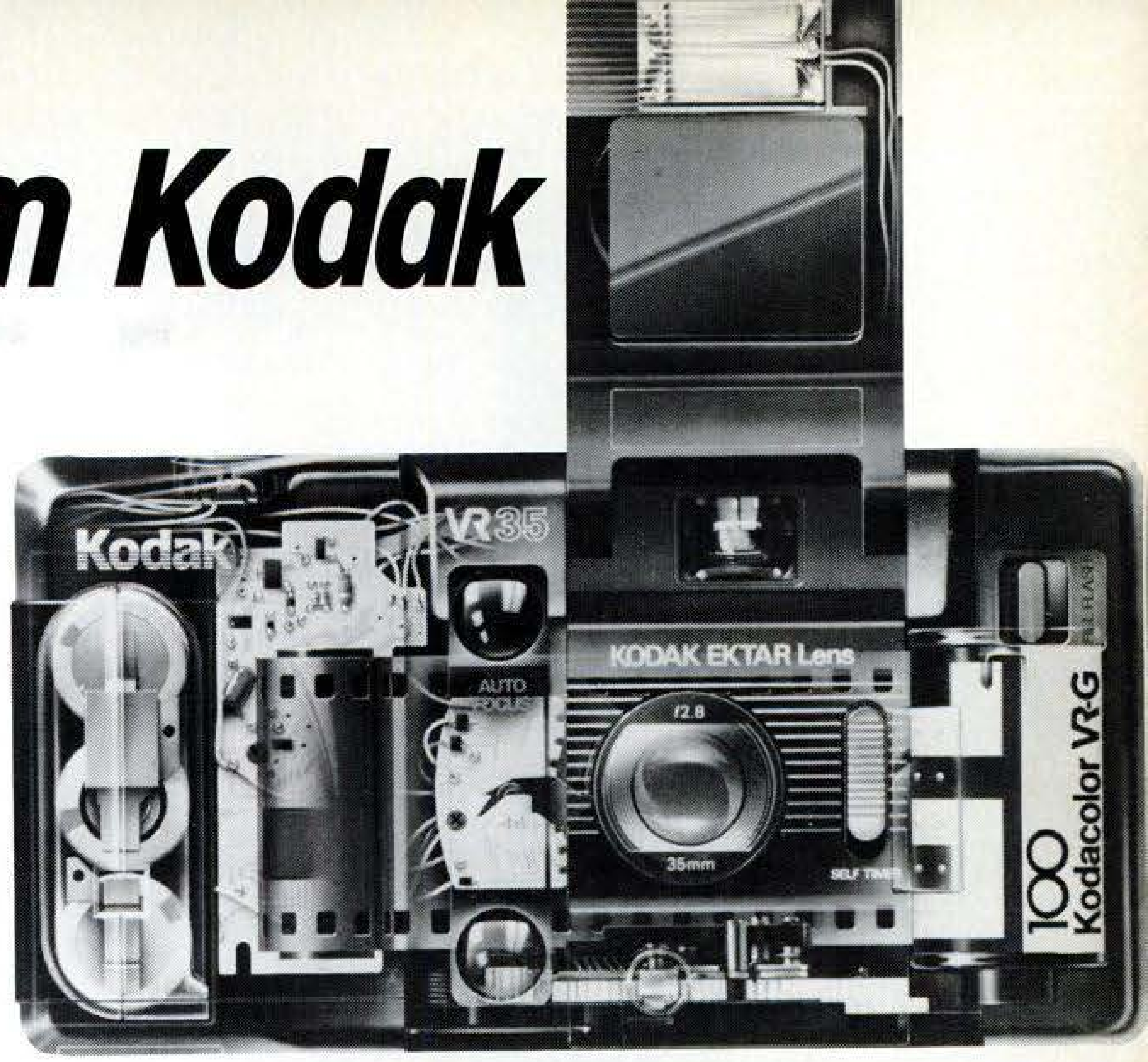

The flash unit and the cameras' other electronics are powered by a nine-volt lithium battery pack, which you can see at the extreme left side of the camera in the phantom view. It makes a bulge that provides a convenient grip, and it is guaranteed for three years, as are the cameras.

For the extra money, the K12 serves up quite a bundle of extras. Its four-element glass lens is sharper and faster, at f/2.8, than the K10's three-element, f/3.5 lens. It even contains an aspheric element—unusual in cameras at this price.

Its focusing system is also more sophisticated than the K10's, with an eight-level autofocusing control as opposed to a three-level control for the K10. Your photos are more likely to be in sharp focus with a more subtly graduated control system. The K12 also focuses from three feet to infinity; the K10, from four feet to infinity.

The Sensalite flash unit in the K12 recycles in 1.7 seconds. Recycling time for the K10 is 2.5 seconds—not an important difference for most users. A more significant advantage for the K12: auto film loading, advance, and rewind. With the K10, your fingers do the work, on a thumbwheel.

Incidentally, if you look at the film cassette in the phantom view, you will notice a new film designation: VR-G 100. It and a new 400-speed film are replacing Kodak's VR 100 and VR 400 print films. Kodak promises "the most realistic color prints in the world" with the new films.

The Proof.

100 new car shoppers* compared Renault Encore to Ford Escort, 79 chose Renault superior overall.

	Driving Ease	Riding Comfort	Comfort/ Convenience	Styling Interior	Styling Exterior	Overall Superiority
Renault Encore S 1.7 litre	77	65	73	72	82	79
Ford Escort L 1.9 litre	23	35	27	28	18	21

Encore continues its winning ways in 1986 with **35 MPG CITY**,[1] that's better than Escort. New options, too: Accusound by Jensen, a premium 6-speaker system and tilt steering wheel. One of America's best small-car protection plans. It covers the powertrain and outer-body rust-through for 5 years, or 50,000 miles.[†] See your Renault dealer for test details. Drive an Encore yourself and let European technology **Built in America** prove its promise to you.

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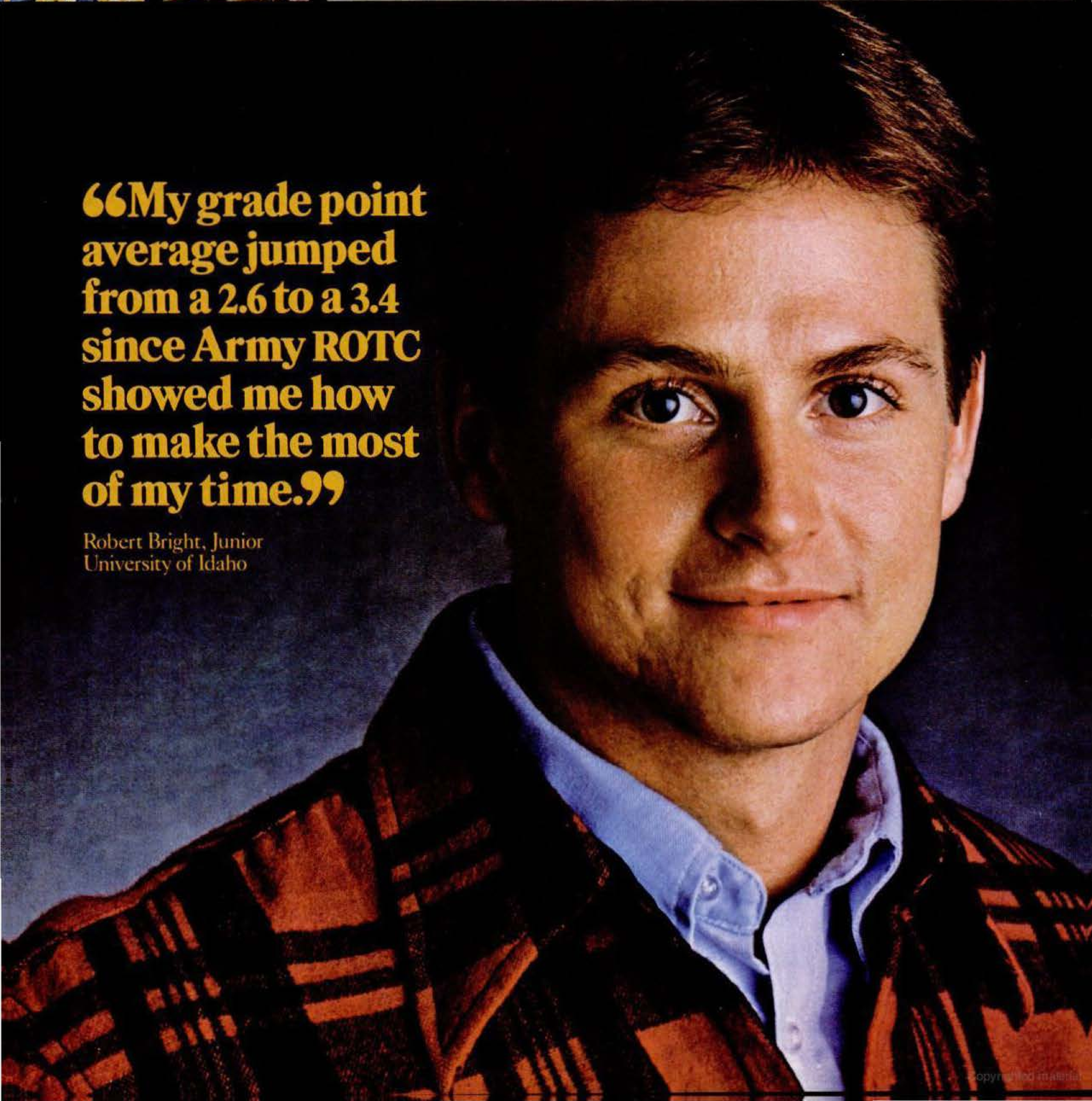
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Robert Bright, Junior
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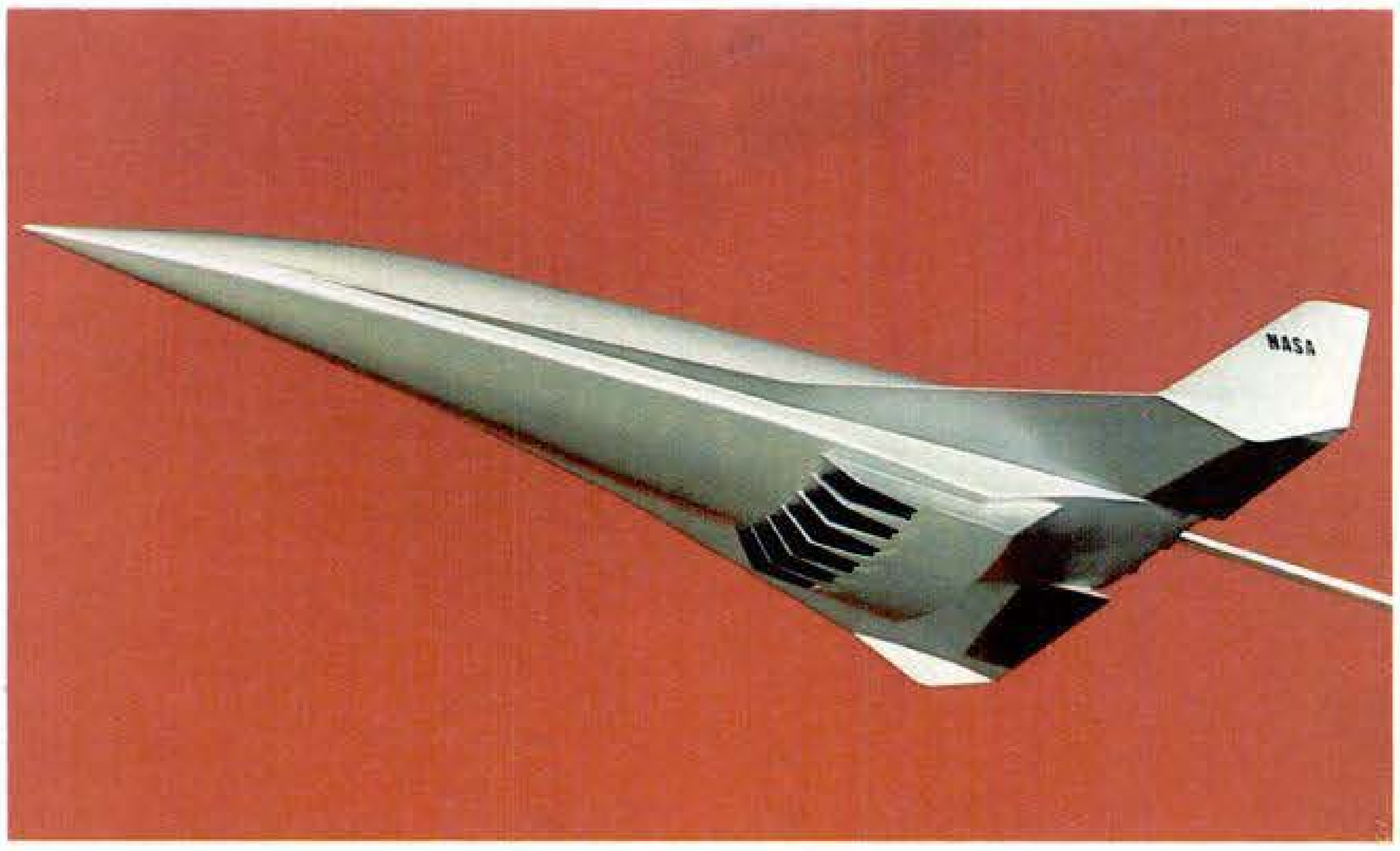
The WHAT'S NEW magazine
Popular Science

What's News

Modern technology produces spacecraft, automobiles with ever-better performance characteristics, electronic devices that do unbelievable things. But technology also produces a host of products that, while perhaps not so spectacular, are highly useful. In this category are the ingenious new knockdown fasteners shown on the cover, which are the subject of a major piece in this issue.

If you have a certain fascination with hardware—as I know from reader mail, most POPULAR SCIENCE readers do—you will be interested in many of these clever fasteners because they solve a lot of problems in ingenious ways. If you're also the kind of hands-on person who is always solving household problems by getting out the tools, then you'll probably find them highly useful as well.



And now a test. What is the device shown on the front cover, and what does it do? Answer: It is a structure designed for showing off as many knockdown fasteners as possible. It has no other purpose. What it does is sit there looking handsome while it has its picture taken. The cover photo, incidentally, was taken by staff photographer Greg Sharko.

Scramjets

In this issue you'll find the first of a two-part series on an entirely new age of aviation just dawning. The Air Force has announced the launching of a program to design and build a plane that can fly into orbit. It will take off from a regular runway using air-breathing engines that can operate up to Mach 6—six times the speed of sound. A later version will use engines that can operate at up to Mach 25—orbital escape speed. Civilian airliners based on this technology will have incredible performance: coast-to-coast flights too short even for the cocktail wagon to get around—Los Angeles to Tokyo in two hours.

You may remember that two decades ago aircraft companies and the military were talking about something called the aerospaceplane. Although the space shuttle eventually grew out of this program, a genuine aerospaceplane was never developed. Technology of that day just wasn't up to the tough problems that have to be solved before such a plane can fly.

That is changing. Several companies are building and testing the engines needed to make this dream come true. That's the subject of Tom Heppenheimer's piece in this issue. Design teams both in the U.S. and abroad are working on innovative airframe designs.

One of the most remarkable designs is shown on this page. It's a NASA-Defense Department development, and several features are worthy of note. The most striking innovation involves the engines. They solve a key problem: At extremely high speed, compression of air produces heating, which if not controlled could destroy the engine. The secret is to keep the airflow supersonic. And the solution is to design the entire underside of the plane—including the parts of the fuselage leading up to the inlets and those at the rear through which the exhaust gases escape—as a single, integrated air-handling system. Aeronautical engineers call the concept airframe-integrated propulsion, and it's likely to be a regular element in the new generation of hypersonic aircraft.

And, incidentally, there is a new *generation*—not just a single airplane. Jim Schefter's article, which will appear in next month's issue, will contain all the details.

Shuttle tragedy

It is ironic that as this issue containing the first of two articles on the development of the aerospaceplane went to press, we received the numbing news of the explosion of the space shuttle *Challenger*. The aerospaceplane is, of course, envisioned in one of its roles as a successor to the shuttle.

What effect will this tragic event have on the future of the U.S. space program? Nobody knows. But it might be well to remember that every worthwhile step in human progress has been accompanied by sacrifice—often of lives. Not all of the early explorers who sailed the mysterious oceans returned. But that didn't stop others. Many brave pioneers gave their lives during the development of aviation. But others kept on. I can't imagine that brave space pioneers will be any different.

CPGilmore
Editor-in-Chief

Scramjets that will reach Mach 25

An air-turbo-ramjet engine fires during a bench test in the Aerojet Techsystems engine-testing laboratory in California.

Jet planes can't fly much faster than they could 20 years ago—about Mach 3. But the U.S. Air Force has announced plans to build aircraft that can circle the globe in 90 minutes. The key? Revolutionary new engines that are now undergoing tests.

By T. A. HEPPENHEIMER

"We don't allow anyone close to the engine when it's firing," project manager Ron Samborsky told me. I had come to Aerojet Techsystems near Sacramento, Calif., to see tests of a radical new aircraft engine, the air turbo-ramjet. Samborsky loaded a videotape as he talked. "During an engine test, we watch inside the control center on closed-circuit TV. Here's what a recent test looked like."

The engine looked somewhat like a cannon, a dark cylinder with a bore up the middle. Suddenly, a thick bright saffron flame shot to the right, accompanied by a loud, continuous roar. Fumes of vapor blew across the scene. The flame wavered and oscillated for a moment, then steadied. It continued in this fashion for some 30 seconds; then the flame and its sound died out. "In an actual test, we can't approach the hot engine for several hours, till technicians have rendered it safe," Samborsky said.

The demonstration I witnessed is part of an ongoing revolution in aircraft engines. Jets had been stuck on dead center for 20 years. In 1965 the SR-71 reconnaissance aircraft, flying at 2,070 mph, was the fastest plane in the world. Today that same craft still holds the record, at 2,193 mph, or Mach 3. (Mach number is the ratio of the plane's speed to the speed of sound at a particular altitude.) One reason is that even high-performing turbojets require turbines (see drawings, next page), and these are vulnerable to the heat generated by air sucked in at supersonic speeds.

But new engines under development will overcome the limitations of the turbojet. With these, aircraft will break their present speed barriers and come to the point at which aircraft merges with spacecraft.

The Defense Advanced Research Projects Agency (DARPA) calls this future craft the aerospaceplane. Different versions have been proposed. One, dubbed the Orient Express, would not leave the atmosphere but could make a trip from Los Angeles to Tokyo in two hours instead of 10. A slightly different version would fly all the way into orbit. "You'd get up there and go," declares Robert Williams, DARPA's project manager. "You wouldn't cruise around, burning up fuel." His colleague Robert Jones agrees: "You would fly up to 200,000 feet, go beyond orbital speed, then coast, till you kick in a rocket."

Last July, Charles Buffalano, acting director of DARPA, announced that his agency intends to undertake a Hypersonic Technology Program to develop the major elements needed for such craft. By December, the Department of Defense had announced a joint push with NASA to develop the plane, with the Air Force coordinating programs among the different Defense Department groups, including DARPA. (See PS next month for the full story of the aerospaceplane.)

Two engines for two speeds

Advances in jet propulsion will set the pace for these spaceplane programs. Williams and Jones assert that these advances can soon be in hand, and will take two radically new forms. The air turbo-ramjet I saw in the Aerojet test lab could operate at speeds up to Mach 6, sufficient to power the Orient Express. The supersonic combustion ramjet, or scramjet, could then take over for flight at higher speeds. At present there is no clear idea of the scramjet's speed limit, but recent computer simulations have shown that it can be designed to work at Mach 25, which is orbital velocity.

These two engines are variants of the ramjet used on some early supersonic missiles. The simplest type of jet engine (see drawings), the ramjet has no moving parts—so it is less vulnerable to the effects of superheated air produced by high-speed flight. But the ram-air effect becomes efficient only at speeds above Mach 1.5.

To get up to supersonic speed, the air turbo-ramjet relies on a compressor and turbine, as does a turbojet. But instead of using heated outside air to drive the turbine, the turbo-ramjet uses hot gas produced by a rocketlike gas generator, which uses no outside air.

The advantage? At high speeds, outside air heats up and threatens to damage the turbine blades. This limits an ordinary jet to Mach 3. But the gas generator keeps the turbo-ramjet's turbine at a constant temperature, allowing the engine to reach transonic speed.

"With existing technology, the air turbo-ramjet should reach speeds of Mach 5," Aerojet's Samborsky said. "To get to Mach 6 we would need advanced materials. DARPA plans to test an ATR [air turbo-ramjet] at the highest speeds and altitudes possible today."

A jet-engine lab at NASA's Lewis Research Center, in Cleveland, is currently being modified for the tests. "We aim to verify that we can really get an engine to work at Mach 5 in a ground facility," says NASA's Robert Coltrin.

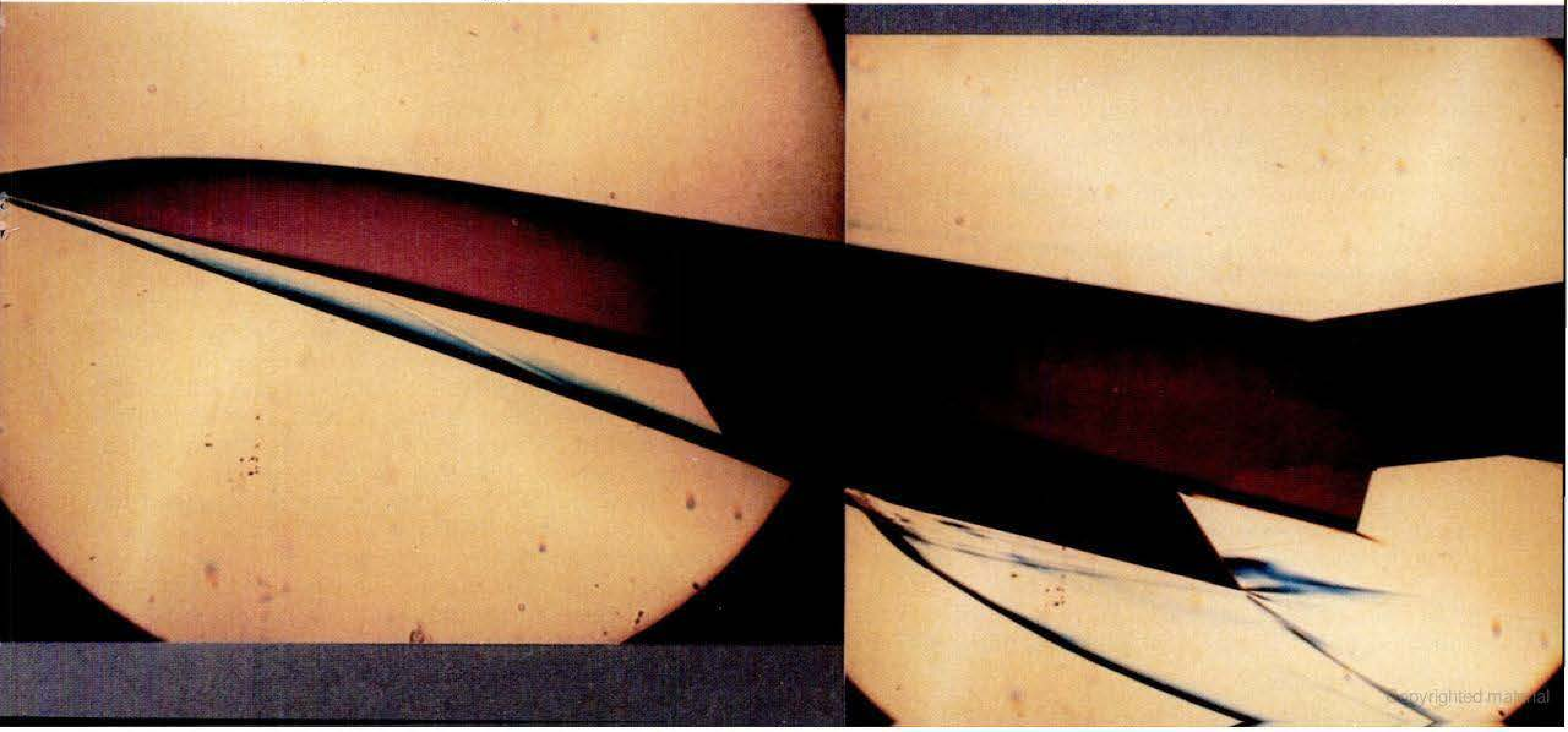
If an air turbo-ramjet were flying at Mach 5 and 100,000 feet, its inlet would ram the incoming air to a pressure of some 100 pounds per square inch and a temperature of 1,800 degrees F. Thus, Lewis's Propulsion Systems Laboratory will feed the experimental engine with air heated and compressed to these values. "An engine only knows the conditions at its inlet and its nozzle," declares lab manager John Dicus. "If you produce the proper conditions, the engine doesn't know if it's on a test stand or if it's flying."

To heat the airflow, Dicus is installing hydrogen burners, which will turn the air into what will literally be the flame of a hydrogen torch. "Our facility runs an airflow of 480 pounds of air per second," Dicus points out. "That's enough to empty a house of its air in two seconds."

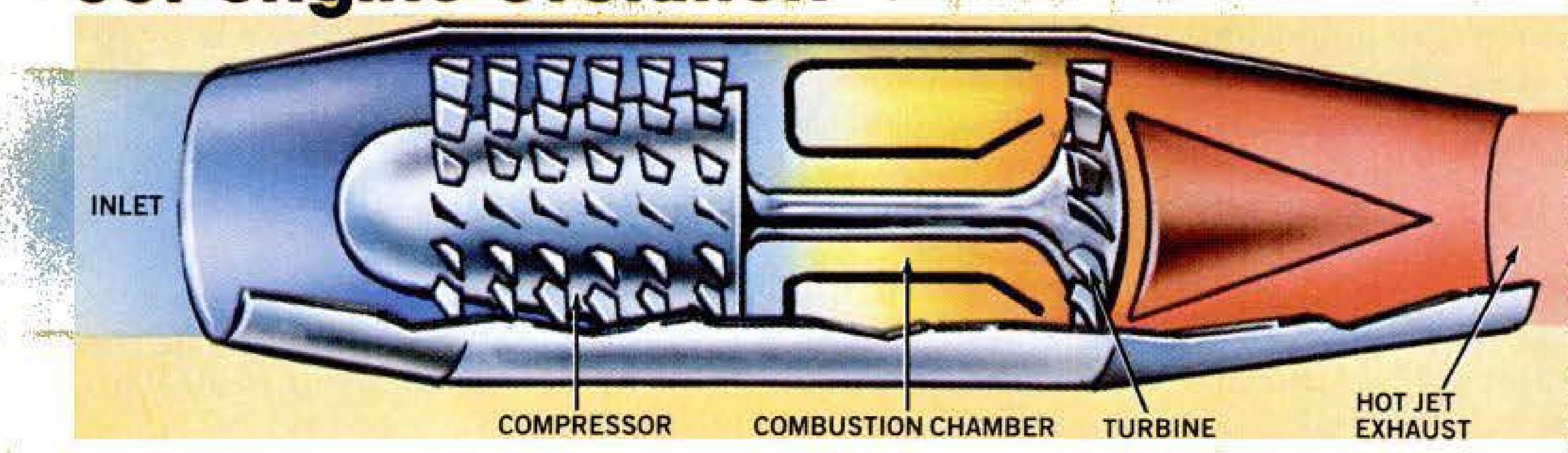
Jet-engine testing has its pitfalls. Four years ago, while testing a prototype of a fighter engine, a shaft failed. In a hundredth of a second, the turbine sped up and flew apart. "It was like shrapnel flying inside the test cell," Dicus recalls. "A piece of the turbine became embedded in the lid like a hatchet in a block of wood. It blew a hole in the tank lid and threw a chunk of the lid across the room."

Continued

Model of a scramjet plane faces hypersonic air currents in the wind tunnel at Langley Research Center's test facility.



Jet-engine evolution

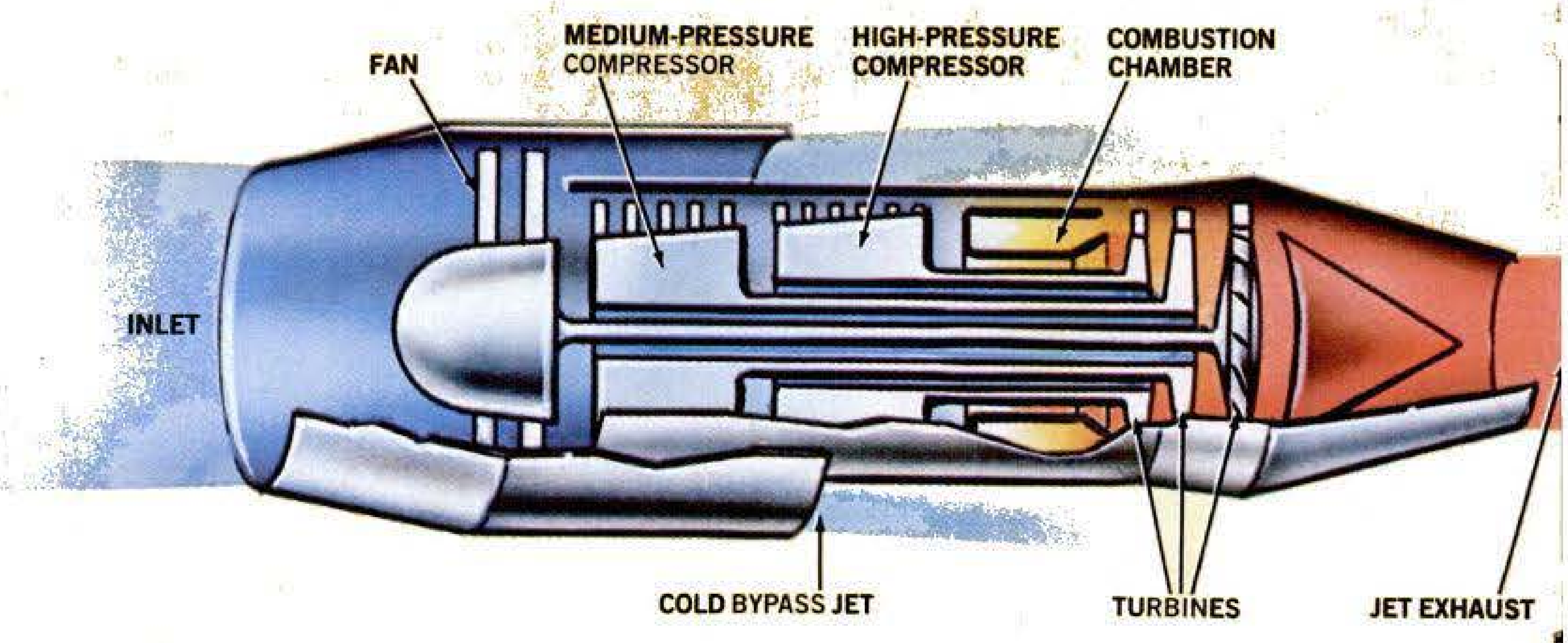


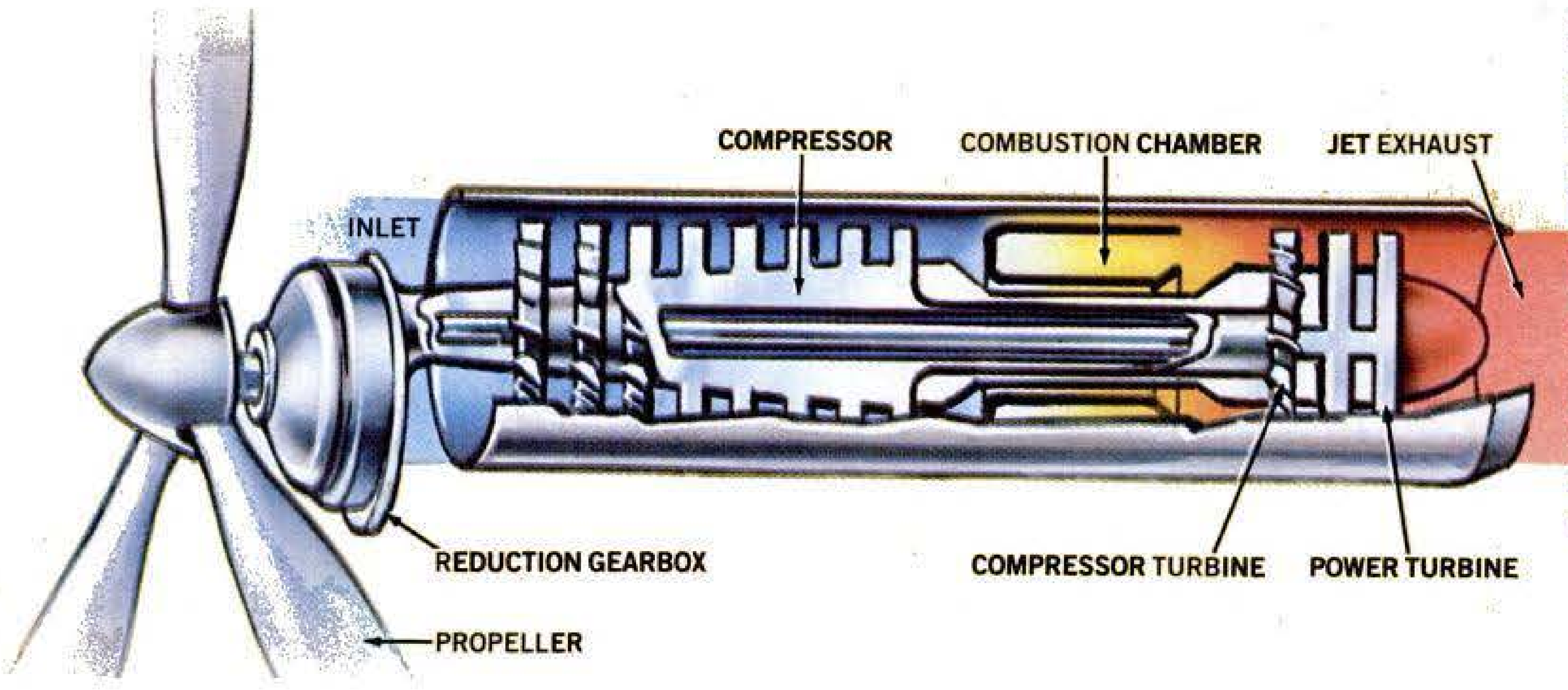
1. Turbojet

The basic design of the turbojet was patented in England in 1930. Air sucked into the inlet is compressed, then burned with fuel in the combustion chamber. The expanding hot gases surge out the nozzle, producing thrust. On their way out, they spin the turbine, which, in turn, powers the compressor. The difference between a jet engine and a rocket engine, which also ejects gas to produce thrust, is that the rocket engine breathes no air—it carries all its own fuel.

2. Fanjet

Air entering a fanjet engine passes through a rotating fan that functions as a low-pressure compressor. Most of the air then passes through two more compressors and then into the combustion chamber. But some of the pressurized air is diverted and ejected directly, becoming a "cold jet." Another fanjet version (not shown) mixes the low-pressure air with the jet exhaust. Either way, the engine's bypass system boosts thrust without using extra fuel.





3. Turboprop

Instead of a fan just inside the engine duct, the turboprop has a forward-mounted propeller. Most of the air bypasses the combustion chamber, and the exhaust jet provides much less thrust than with other engines. Still, reduction gearing is needed to slow the high-speed, turbine-powered shaft down to speeds suitable for propellers. Turboprops have high efficiency at speeds below 500 mph and have high output at low forward speeds.

He pointed to a thick steel ring, a girdle surrounding the turbine of an engine under test. "We've used that girdle for safety ever since."

The scramjet—the theoretical second engine on the spaceplane—presents a different set of problems.

"It's more difficult to develop scramjets," declared Ernest Mackley, who is directing NASA's work in this area from its Langley Research Center. "The facility requirements are much more stringent. You have to duplicate the temperature; if you don't, you won't get the right results. We're reaching further; it's going to take more effort."

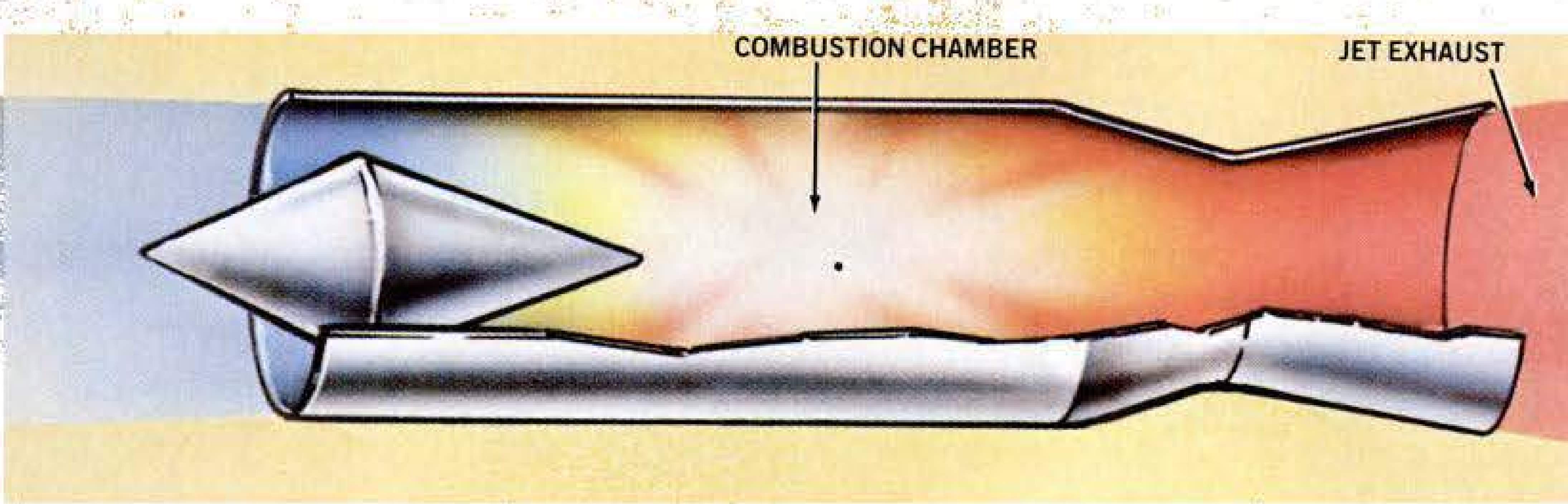
At Mach 6, aerodynamic heating of an aircraft engine can reach 2,800 degrees F, which is close to the limit for the most heat-resistant materials. However, such temperatures are reached only when the airflow slows almost to a halt inside the engine during combustion. Thus, the path to higher speeds lies in permitting supersonic flows—which are cooler—within a ramjet.

In Langley's Scramjet Test Facility, the airflow reaches Mach 7. To get there, Mackley relies on an electric arc. The bright blue-white spark—three feet long and three inches across—writhes within a magnetic field so the electrodes won't overheat. Twenty megawatts of power drive that spark, carrying 13,000 amperes of current. Air flowing past the arc heats close to the temperature of the sun's surface—10,000 degrees F.

The superheated air then mixes with additional air and is diluted to 4,000 degrees before expanding through a rocketlike nozzle to reach its high speed. Fifty thousand gallons of water serve for cooling at the end of the experiment. "Put your hand on this nozzle," said one of Mackley's engineers. "We finished testing an hour ago." The nozzle was still hot, like a stove burner only recently turned off.

"We have been doing research on scramjets above Mach 6," Mackley went on. "We can get performance up to ten times that of a rocket, with hydrogen as fuel."

Hydrogen theoretically burns fast enough for combustion in a supersonic airstream, he explained. "The problem is, you have so little time to have the fuel react. You have only a millisecond for the fuel to be injected, mixed,

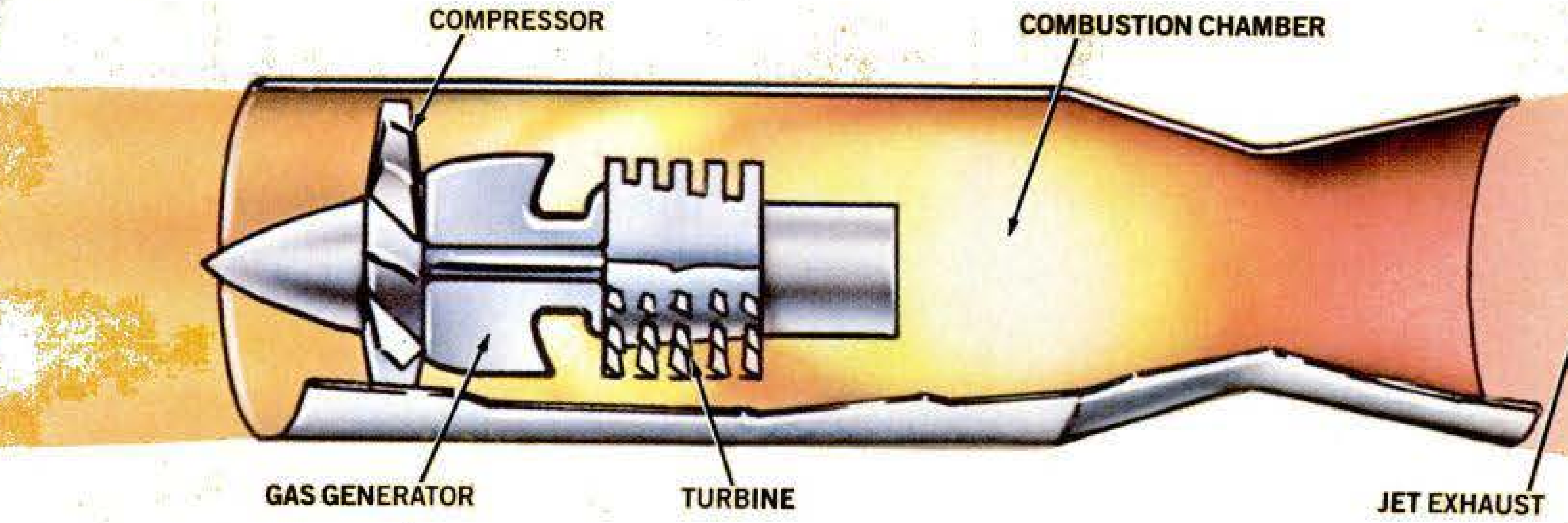


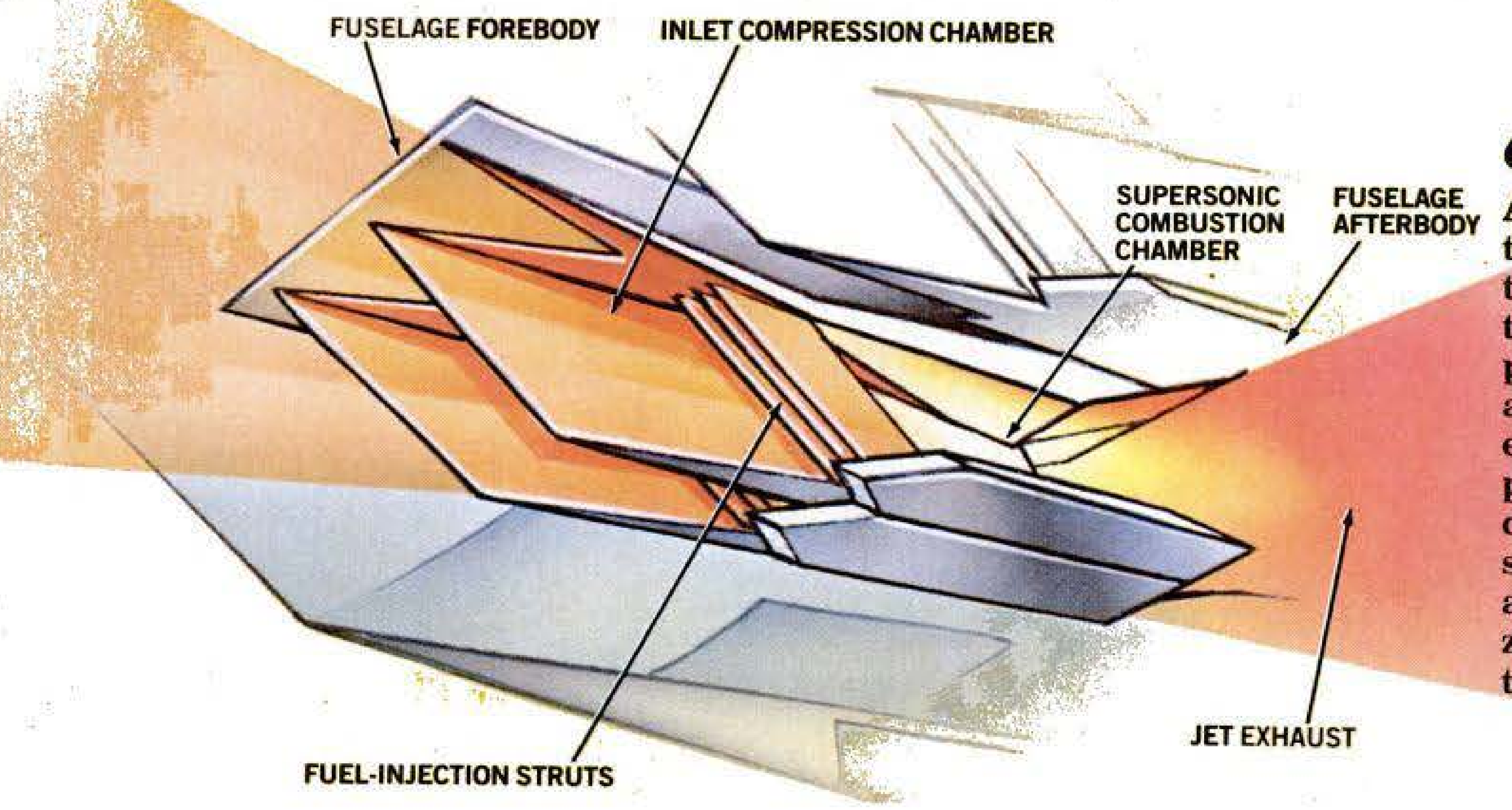
4. Ramjet

The ramjet, the simplest jet engine, uses no turbine or compressor; it relies on its forward motion to ram air into its combustor. The air, heated and compressed in the ramming, then mixes with fuel and burns. Another engine must bring the ramjet up to speed, because the air-ramming effect cannot keep the engine's flame from blowing out the front end at speeds below Mach 1.5. Above Mach 6, heating caused by high air pressure at high speed is too severe for engine components.

5. Air turbo-ramjet

A superspeed hybrid, the air turbo-ramjet has a rocketlike burner that uses hydrogen fuel and liquid oxygen. The gas generator produces a fuel-rich exhaust that spins a turbine to drive a compressor as in a standard jet—so the engine can start at 0 mph. But the compressed air bypasses the burner, mixing directly with its exhaust to give thrust—enough to carry an aircraft to Mach 5. The turbine is not heated by the ram air, so its blades stay cool.





6. Scramjet

A scramjet module is one of several that would be mounted midway under the aerospaceplane's fuselage. The entire underbody of the fuselage is really part of the engine. The forward part acts as the inlet, channeling air into the engine. The inlet slows down the supersonic air only slightly so the engine does not overheat. Fuel-injection struts supply hydrogen for a fast burn. The aircraft's aft underbody acts as a nozzle, allowing the exhaust gas to expand to produce more thrust.

and burned. Only recently have we been able to get really good performance."

He opened up a three-foot-long flat container lined with plastic foam. Inside was what appeared to be a blue swept-back wing for a large model aircraft. It was a mock-up of a fuel-injecting strut, which will be mounted in a scramjet engine. "We think it's the most critical item," Mackley declared. "We're going to expose it to very hot streams: Heat it to 3,400 degrees, cool it, heat it again—all at Mach 7. We're going to see how it stands up to repeated cycles."

Down a hallway, a small scramjet engine sat on a table. "This is the Three-Strut Scramjet," Mackley said. A rectangular duct made of nickel with a swept-back front inlet, it is eight inches high and five feet long; I could easily look down its entire length. Three small struts cross its interior to inject fuel. Its edges are very sharp; rubber tubes had been fitted over them for safety. The sharp edges are needed to produce the weak bow wave that slows the supersonic airflow down slightly so it won't blow out the burning hydrogen.

Within the Scramjet Test Facility, small engines like the one I saw have ejected long bright flames, blue-green from impurities in the air. According to DARPA's Buffalano, their performance has been "sufficient for acceleration of a large aircraft."

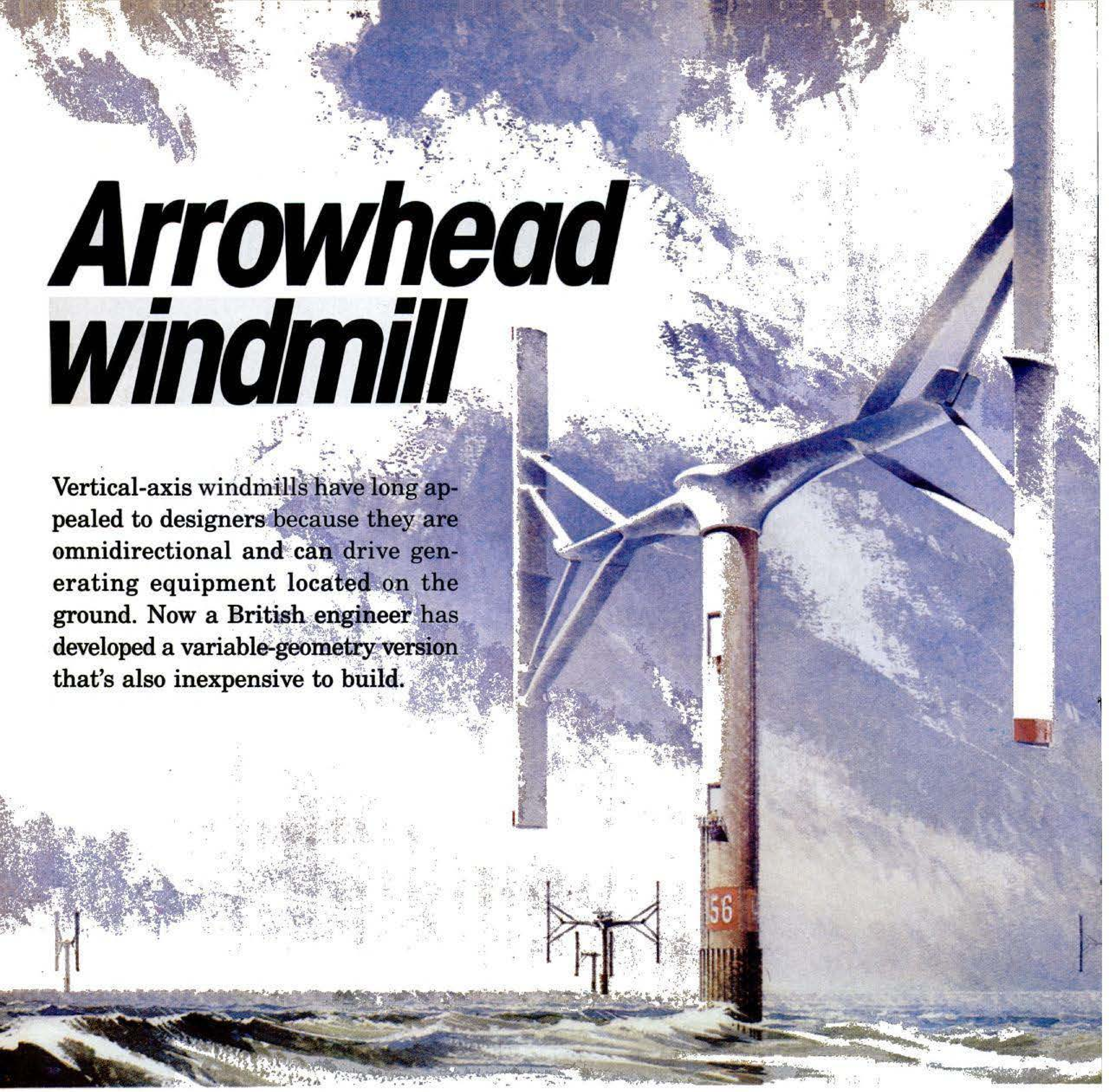
"We think our technology could be extended to Mach 10 or 12," Mackley said. "Beyond that, we just don't have a lot of information." To achieve a steady Mach 12 airflow for the testing of scramjets, it would be necessary to heat the air to more than 11,000 degrees F, which is quite impractical. Thus, scramjet designers intend to rely on computations carried out with highly advanced supercomputers. These computers will seek to simulate the details of the ultra-high-speed airflows by solving appropriate sets of equations.

DARPA has recently shown the promise of this approach. Using the best computers and programs available today, its researchers have proposed scramjet designs that can operate at Mach 25. The key to success will be the

[Continued on page 136]

Arrowhead windmill

Vertical-axis windmills have long appealed to designers because they are omnidirectional and can drive generating equipment located on the ground. Now a British engineer has developed a variable-geometry version that's also inexpensive to build.



By DAVID SCOTT

READING, ENGLAND

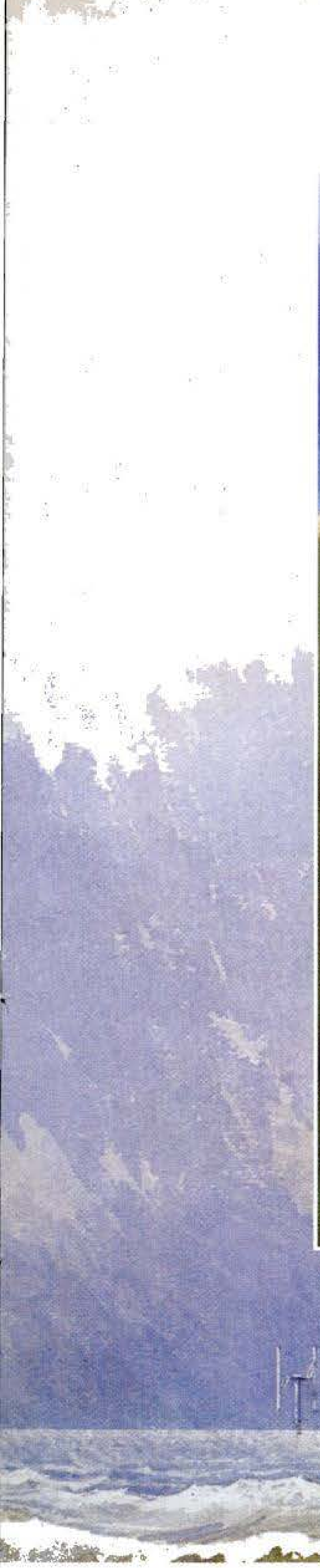
Leaning across his paper-strewn desk at Reading University, where he heads the engineering department's energy group, Dr. Peter Musgrove was intent on explaining the features of his vertical-axis wind turbine. "It's got many advantages over the usual horizontal-axis turbine," he told me. "The first big point is that it's omnidirectional; no steering mechanism is needed to head the rotor into the wind, which cuts complexity and cost."

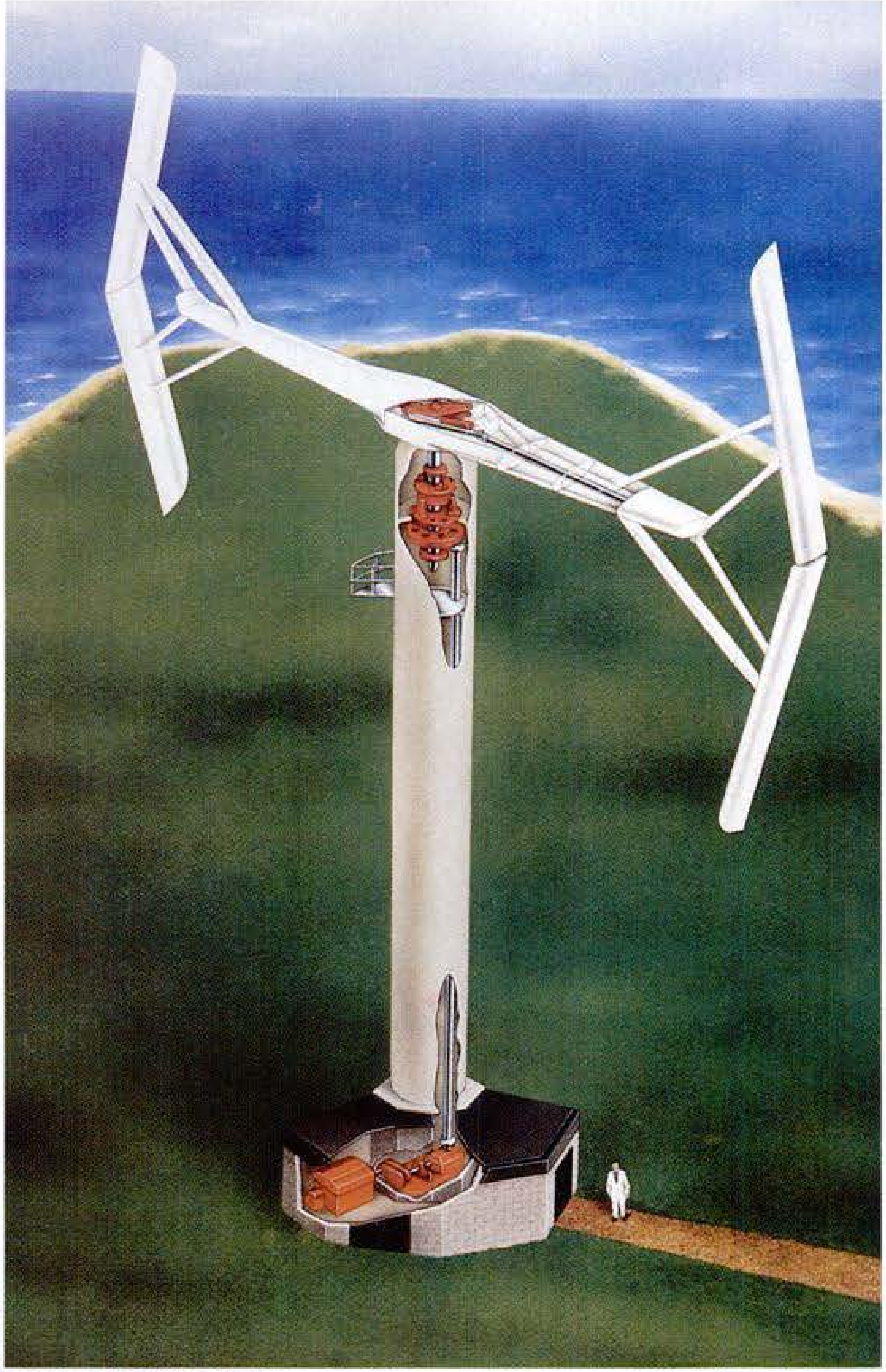
With a traditional horizontal layout, Musgrove continued, the rotor nacelle must house either the entire gearbox and generator or bulky right-angle bevel gearing, which makes the tower top-heavy and expensive.

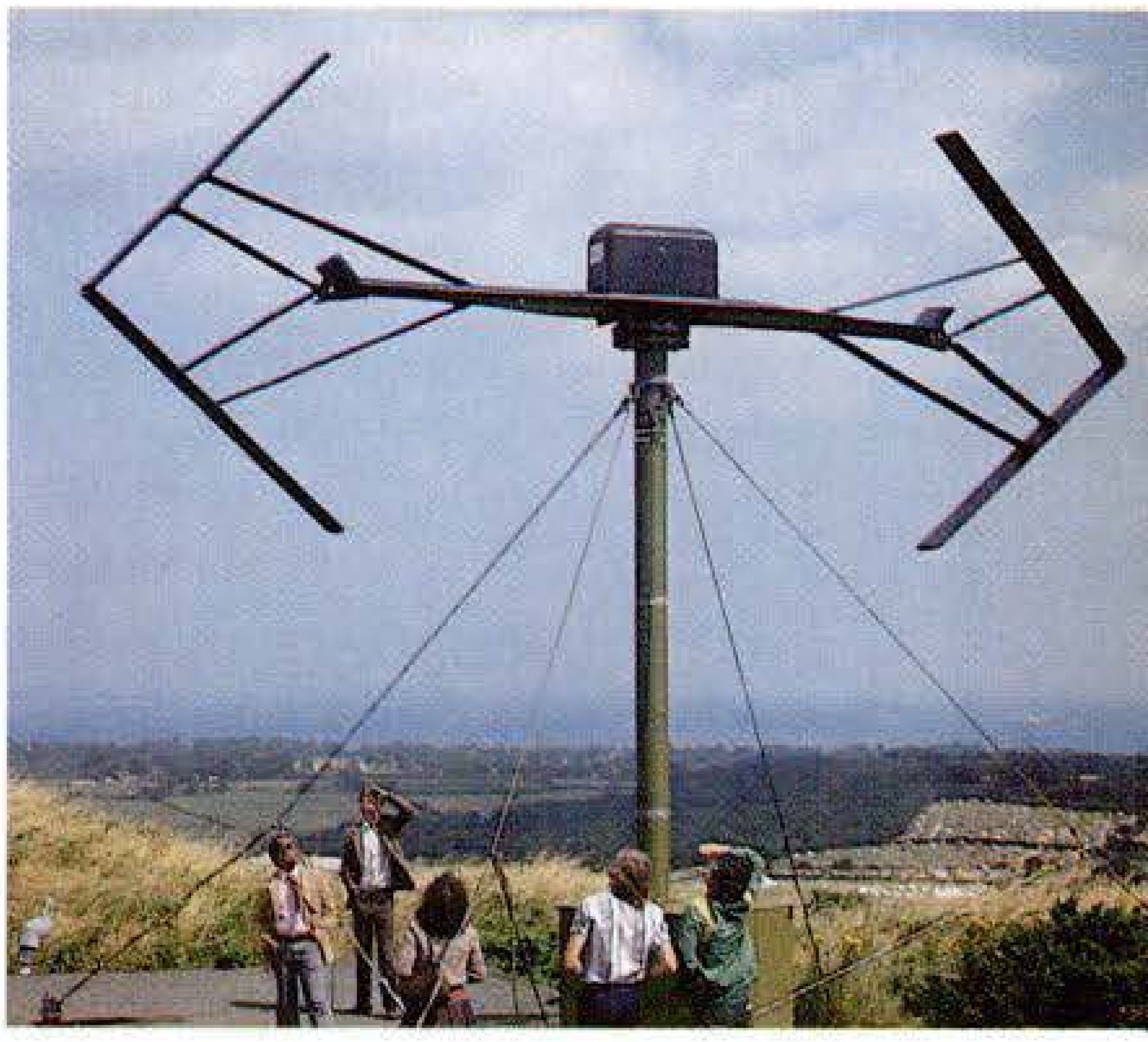
Further, vertical windmill blades have a constant airfoil section along their length, making them simple and cheap to produce. With these points in their favor, Musgrove feels that vertical-axis turbines are now a viable candidate for commercial electricity generation. His grandest scenario envisages offshore wind farms of perhaps 150 giant turbines with 300-foot-diameter rotors grouped together.

The vertical-axis concept is not new. It dates back 50 years to the original Darrieus design, which had two or more curved blades of looping "troposkein" form, similar to the natural line taken by a jump rope in midair. Musgrove began working with the Darrieus rotor at Reading in 1974, but he soon became aware that it had several drawbacks.

"The blades are difficult to make," he told me, "and only the central portions produce useful energy. They have a fixed pitch, so they can't be feathered to control power output. And the greater height of the rotor compared with a conventional turbine requires a taller tower, usually with guy wires that take up a large amount of ground area."







Planted on the sea bottom in shallow offshore waters (opposite page), vertical-axis turbines in this wind-farm concept stand on 250-ft. towers. Each 75-ton rotor powers a 3-MW generator. Locating windmills at sea reduces their noise impact. An arrowhead windmill being built in Wales (left) contains only first-stage step-up gearing at the top of the tower. This design minimizes the weight the tower must support. The drive shaft powers a second-stage gearbox and generating equipment located in the base of the 80-ft. tower, where it is easily accessible for maintenance. An experimental windmill (above) is located on the Isle of Wight. Hinged blades pivot on longer support struts; shorter struts are moved in and out by sliding links in the crossarm. Varying the swept area controls rotor speed.

From this starting point, Musgrove progressed to an H-shaped rotor configuration, which provides speed control by pivoting the upper tips of its two blades outward as it reaches design speed. The resulting V-shape has less swept area, so the rotor slows down. I saw a prototype running at the nearby Rutherford Appleton Laboratory, which works closely with Reading on the windmill project. It has a 20-foot-diameter rotor that drives a five-kilowatt generator located in a small shed. Extensive tests with this rig led to a major design improvement: arrowhead blades.

These two-piece blades are centrally hinged to the crossarm. As before, they normally run straight and upright for maximum energy absorption. But with increasing wind speeds, the rotors fold inward, decreasing frontal area without causing unwanted vertical forces—a nasty tendency of the H-pattern rotors. The arrowhead-blade angles are adjusted by hydraulically activated push rods that are controlled by a wind-speed sensor linked to a computer. A machine of this type, about the size of the Rutherford unit, has been operating since 1982 at Bembridge, on the Isle of Wight.

Now a much larger 150-kilowatt arrowhead turbine is under construction at Camarthen Bay, in Wales, with initial operation scheduled for next spring. It has an 82-foot-diameter rotor with steel arrowhead blades turning at up to 28 rpm. Blade angling to maintain constant speed is controlled by monitoring the generator's voltage output. Says Musgrove, "That's simpler and more effective than measuring wind velocity with an anemometer, which merely samples one point in space. Average speed across the swept area is what counts, so we're using the windmill itself as a sensor."

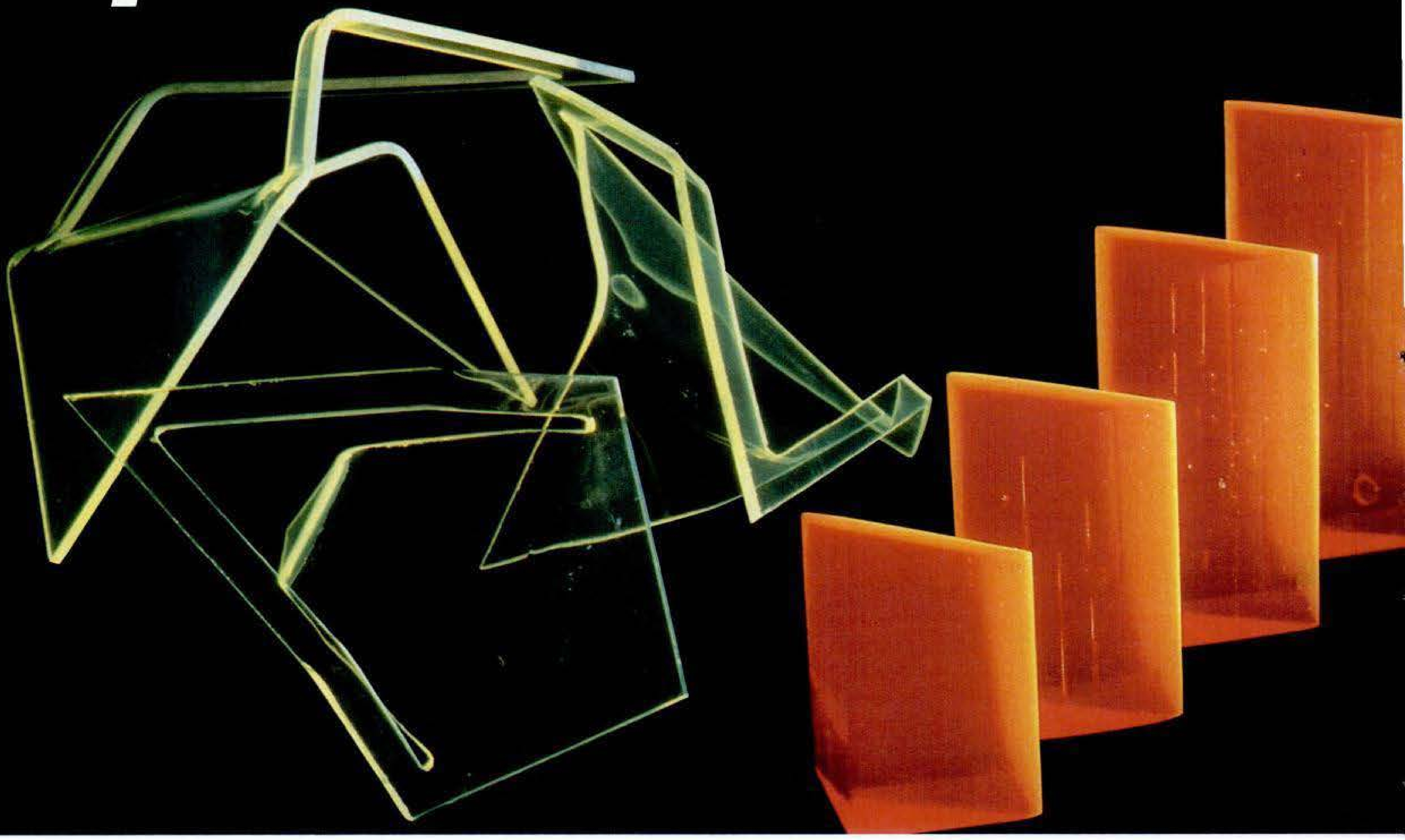
The 150-kilowatt machine, to be on trial for two years, is a one-quarter scale prototype of future windmills Musgrove sees making an important contribution to Britain's electricity needs. The British government apparently thinks similarly: Funding for alternate-energy research is now heavily biased toward wind-power projects at the expense of ocean-wave and solar-power efforts.

Another small prototype commercial windmill, intended for islands and other remote communities, is in the late stages of fabrication. Its 56-foot arrowhead rotor will produce 100 kilowatts of electricity. Testing of the windmill will be conducted on the Scilly Isles, off the southeastern coast of England.

It looks as if this latest generation of wind turbines may be about to break out of university-research-project status and into the marketplace: Several British construction firms have already formed a business consortium to get in on the vertical-axis act. PS

Razzle-dazzle plastic

Brilliantly colored plastic created with new fluorescent dyestuffs developed in West Germany may turn up soon in thousands of highly visible applications—signs, pop jewelry, toys, roadside reflectors, auto dashboards, aircraft cockpits, and high-contrast liquid-crystal displays. The plastic's ability to capture light, funnel it to an edge, and emit it with great intensity may also improve solar-cell efficiency.



By STEVEN ASHLEY

For the third time in as many visits, the salesman slides his business card across the table toward the company president. Unlike the previous two sales calls, however, this time the president immediately snatches it up, exclaiming, "Hey, you've got a new title." "No," the salesman replies, "it's the same as before. It's just the first time you actually read it." The reason? The card's lettering and edges glow in the daylight as if it were a miniature neon sign.

The neon-effect business card, like the one shown above, is the first application in the United States of new colored plastics from West Germany that throw off intense fluorescent light from their edges and from lines inscribed on their surfaces. These Lisa plastics (short for "lichtsammeln," the German term for light-collecting) will soon be popping up in all kinds of attention-grabbing applications, says George Schexnayder of Mobay Chemical Corp., in Pittsburgh.

When Lisa plastics are backlighted with low-power fluorescent lights, Schexnayder explains, they can function as low-cost simulated-neon, or neo-neon signs, suitable for punching up advertising signs and displays. Ultraviolet light causes Lisa plastics to fluoresce even more brilliantly, Schexnayder adds, making them useful for discos and the like.

Though neon displays are still the foremost attention-attracting medium, their relatively high cost and power demands, as well as the fragility of the tubes, has led display manufacturers like Dan Esser, president of Brookfield Plastics (Brookfield, Wis.), to search for alternatives. Esser thinks he's found it. "Right now, there isn't anything around like Lisa," he says. "You can mill letters into the back surface to create new edges, or you can print the letters in white ink so the light will scatter out through the front face."

Significant engineering uses for Lisa plastics are also emerging, Mobay's Schexnayder notes. Auto manufacturers are looking at them for use

HOTEL
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in instrument-panel displays; the military is considering them for aircraft cockpit displays and night-vision goggles; and computer makers are testing to see whether a film coating of Lisa plastic could improve the contrast of liquid-crystal panels.

Light-intensifying plastics have been seen before, but, unlike Lisa, all previous fluorescent plastics rapidly degraded with weathering and exposure to ultraviolet light. Schexnayder says that Lisa plastic is more lightfast and stable than earlier types.

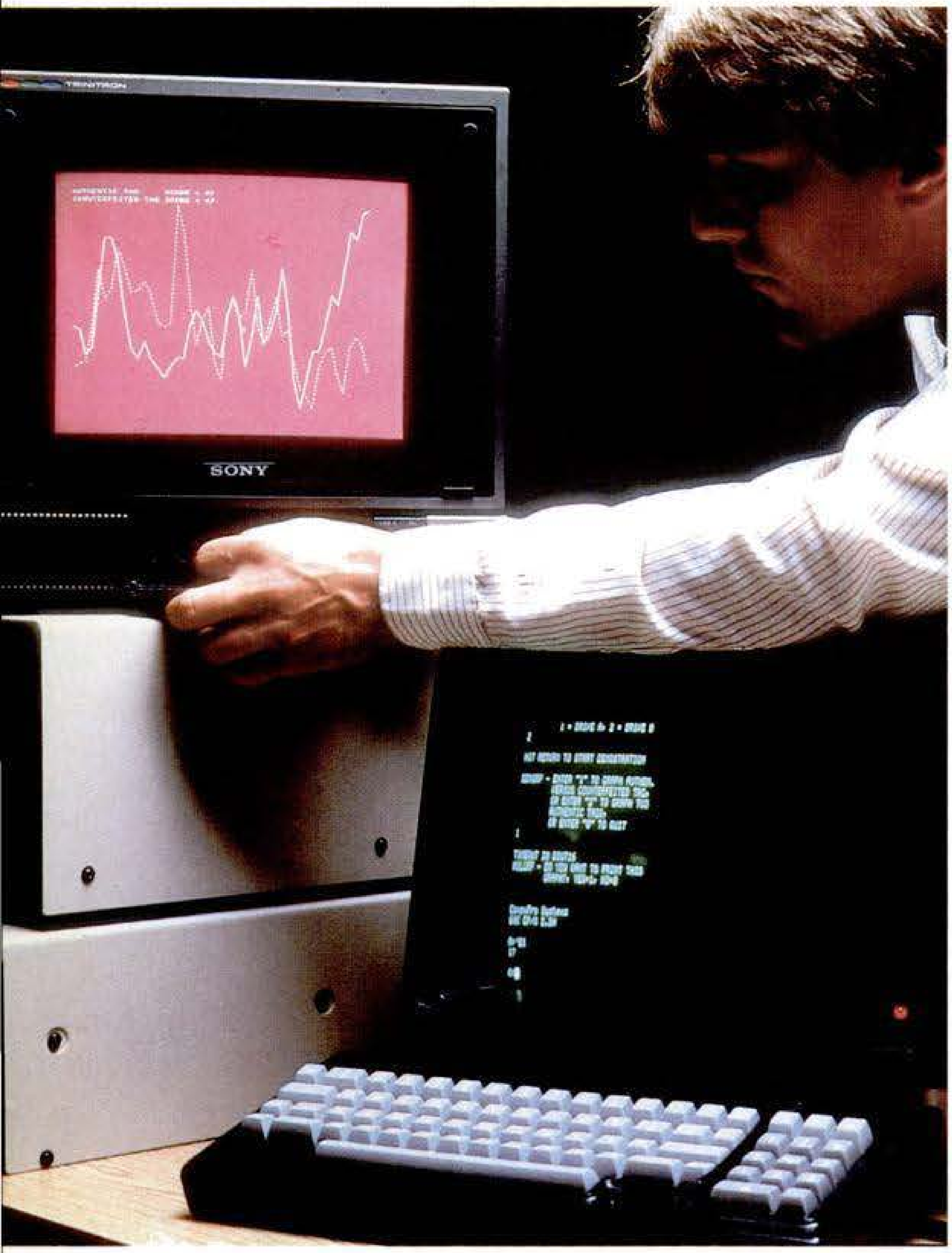
The secret is a patented low-molecular-weight polymer dyestuff developed several years ago by chemists at Mobay's parent firm, Bayer AG, in Leverkusen, West Germany. When mixed into a compatible transparent plastic host medium, the minute dyestuff particles absorb ambient light and emit it as longer-wavelength visible light. Previous fluorescent dyes radiate much of the light they absorb as invisible heat. They also absorb the light emitted by other dye particles, thus stopping the light from reaching the object's surface. The Lisa dyestuffs do not strongly reabsorb the visible longer-wavelength light they emit, so more of the light finds its way to the surface and, thus, to the eye.

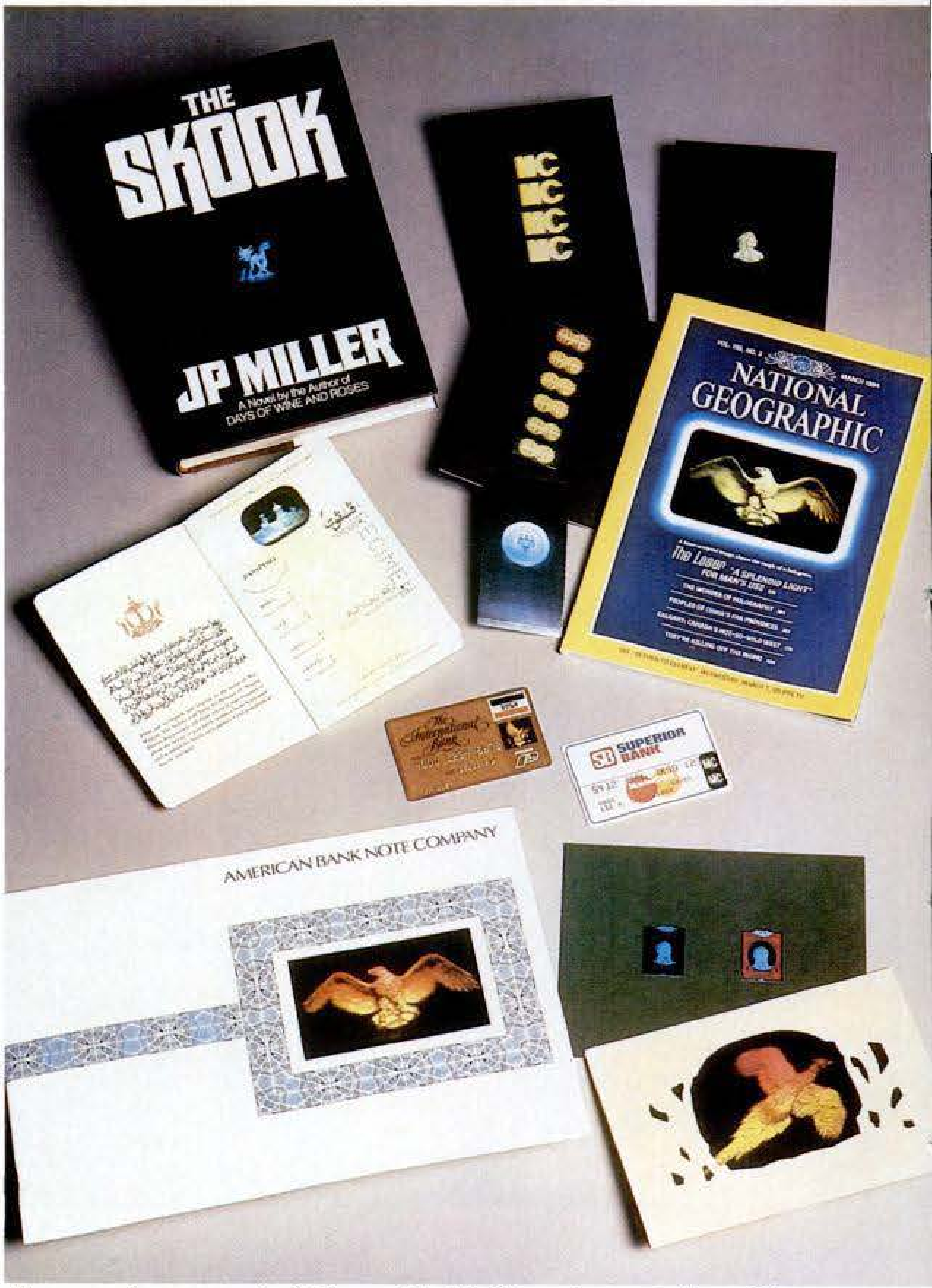
The edges of a sheet of Lisa plastic glow more brightly than the broader surfaces because about 75 percent of the light that enters the plastic reflects back and forth off the internal faces until it escapes at an edge or an inscribed line. The rest of the light exits through the broad surfaces. Schexnayder says that Lisa's ability to act as a light guide or pipe is being tested to determine whether it can improve solar-cell efficiency by concentrating the incoming radiant energy.

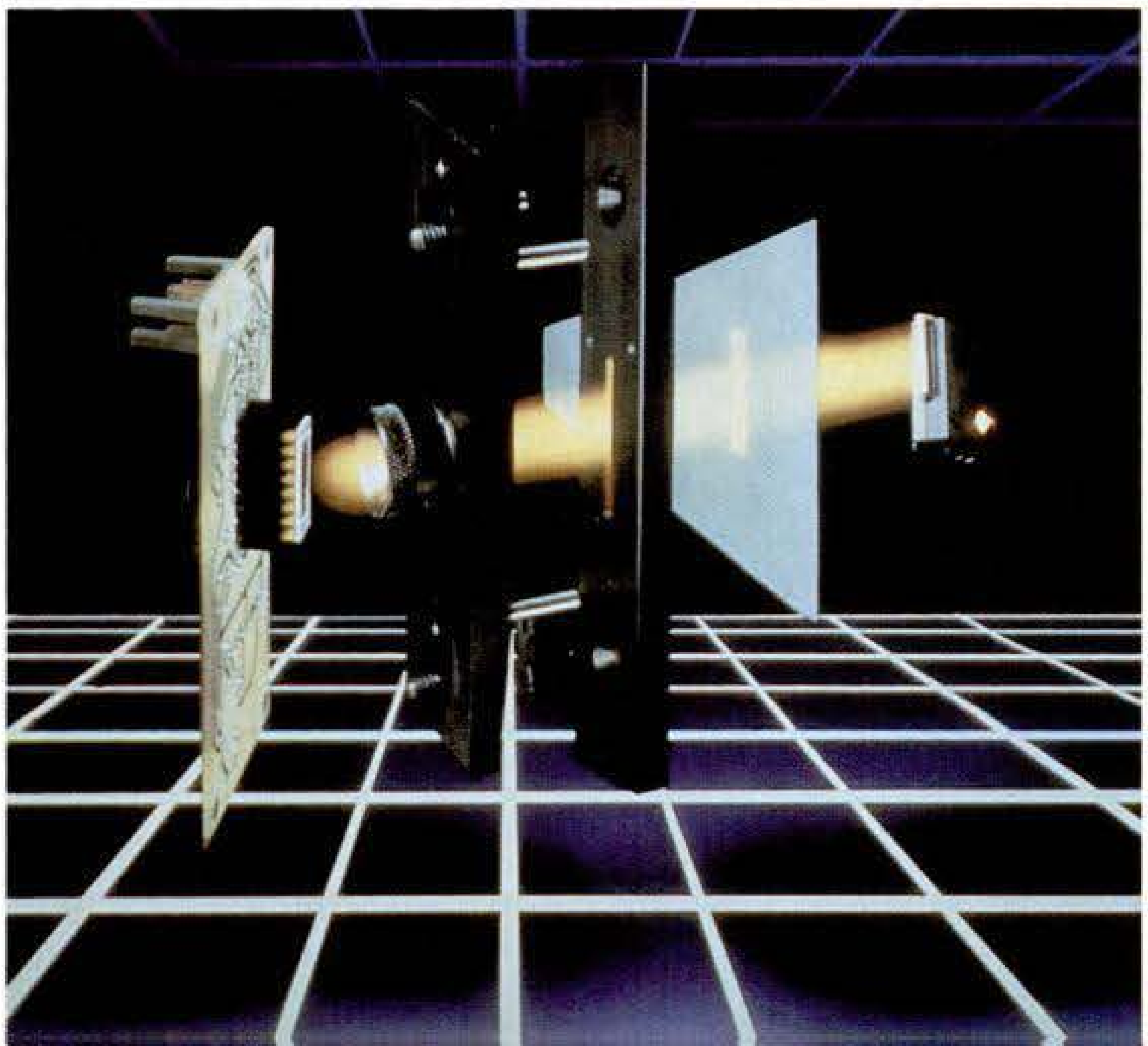
Mobay sells Lisa in acrylic and polycarbonate bases, though the company can supply the dyes in other plastics, such as polystyrene, polyvinyl chloride, and cellulosics, as well as some epoxy and urethane-based thermosets. Colors include blue, green, yellow, orange, red, and deep red. Lisa plastic is available in film, sheet, and rod. A 0.12-inch-thick acrylic sheet costs about $3 to $4 per square foot.

Fakebusters

—how technology spots counterfeits


SONY
TRINITRON


THE SKOOK
JP MILLER
A Novel by the Author of DAYS OF WINE AND ROSES
NATIONAL GEOGRAPHIC
The Laser "A SPLENDID LIGHT" FOR MAN'S USE
SUPERIOR BANK
AMERICAN BANK NOTE COMPANY



To counter counterfeiters, Light Signatures takes fiber-pattern "fingerprints" of labels, which are verified by inspection in the machine shown above left. If the wave patterns on the oscilloscope do not match, the label is counterfeit. The diagram at left shows the steps involved in taking the fingerprint. A high-intensity light beam is passed through the label, creating a shadow of its unique fiber-structure—its "signature." The beam then passes through a lens, which focuses the light pattern onto a diode array, where it is translated into a wave pattern. This analog data is digitized and transformed through a secret code into a number, which is printed on the label. American Bank Note Co. uses another approach to foil counterfeiters: holograms, which are difficult to produce and can be verified on sight. ABN creates holograms for use on passports, credit cards, and other security documents (above). The laser-generated holograms are stamped onto sheets of extremely thin (0.00004 in. thick) metalized plastic. Any attempt to remove the holograms destroys the image.

Counterfeiting is booming. No product is safe from forgery, with counterfeiters knocking off everything from sunglasses and watches to prescription drugs and helicopter parts. Billions of dollars are being lost each year by U.S. businesses, and consumers are getting shoddy and sometimes dangerous products. To fight back, many companies are turning to anticounterfeiting systems. This has spawned a host of sophisticated technologies.

By MICHAEL NEUBARTH

"Come closer. Don't let anyone see," he whispered, huddling over his attaché case on the table before us. Holding the lid low and hunching over the case to prevent others in the room from glimpsing its contents, he reached in and picked up a plastic handgun-like device. Placing the front of the gun to a small metal disc, he squeezed the trigger: A number appeared on a tiny LCD screen on the back of the gun. "That number tells you it's authentic," he said. "If no number appears, it's counterfeit."

The man giving this cloak-and-dagger demonstration was David Johnson, a marketing representative for Allied Corp. The occasion was the Technology Task Force meeting at the International Anticounterfeiting Coalition's annual conference in New York. Gathered were representatives of companies that manufacture systems designed to combat counterfeiting.

The new anticounterfeiting industry, whose representatives attended the conference, is taking off. The reason: Counterfeiting has become a serious problem. Spurred on by the potentially huge profits to be made selling phony products, counterfeiters are forging everything: jeans, cosmetics, records, tapes, credit cards, rail passes, stock certificates, auto and aircraft parts, drugs, medical supplies, computers, and Cabbage Patch dolls. On the corner of my office building on Madison Avenue men sell look-alike "Gucci" and "Cartier" watches and "Porsche" sunglasses. Many people knowingly buy these name-brand imitations, purchasing an ersatz status item at a bargain price.

Buying a bogus watch may be harmless, even fashionable. But counterfeit products like aircraft parts, drugs, and auto parts can be dangerous. A pilot was killed in a helicopter crash caused by an inferior counterfeit part in California, and 15 people died when a bus went off a cliff in Canada because of faulty counterfeit brakes. A shipment of counterfeit birth control pills caused at least one woman to become pregnant, and induced bleeding in others. It's a big money issue, too: Manufacturers in the U. S. lost an estimated $10 billion to $60 billion last year.

With counterfeiting rampant, many companies are investing in anticounterfeiting systems, and many more are looking into them. And, with a new multi-million dollar business thus created, companies all over the country are scrambling to find new high-tech ways of spotting fakes. It's a highly competitive business, which accounts for the secrecy of the demonstration described above. It's also a business that is developing a wide variety of ways of detecting counterfeits. Some systems need only the human eye as detector, while others require expensive scanners to tell the genuine from the counterfeit.

Unduplicability is the key

Counterfeiters today are capable of making convincing look-alike imitations, or knock-offs, of almost any product. The key to protecting a genuine product is to devise a labeling method too difficult or expensive for a counterfeiter to copy. Once you've spotted the fakes, you have a chance of finding the source and stopping the flow.

For example, several years ago the well-known jeans maker, Levi Strauss & Co., found that counterfeit Levis were beginning to be a problem. After evaluating a number of systems, the company chose one from Light Signatures, in Pasadena, Calif. Light Signatures had developed an ingenious system based on the principle that no two things in nature are exactly alike. A high-intensity beam of light is shone through a section of a paper label. A detector on the other side can see and analyze the shadow of the paper's unique fiber pattern. This pattern thus becomes a "signature"—similar in principle to a fingerprint. The label's shadow is electronically translated into a wave pattern, which is converted into digital data, which is finally expressed as a number. The number is then printed on the label. To verify a label, a light beam again is passed through it to get a wave pattern. Then the label is fed into a machine that reads its number and deduces a wave pattern. The two waves are compared, one on top of the other, in the machine. If the two patterns don't correspond, the label is counterfeit.

Levi Strauss began putting coded labels on jeans in 1982. A tag on each pair of jeans asked the customer to send in the label and give information about where he bought the pants. The company also asked some distributors to clip a sampling of the labels and send them to the company for analysis. A short time later fake labels began to show up from the Southeast and Ohio. Levi Strauss moved in, working with the local authorities (counterfeiting goods became illegal in 1984), and stopped the counterfeiters.

Levi Strauss, like most other companies, refuses to give many details of the operation. But the effort apparently worked, and the company is still using the system. "Four years ago," says Peter Phillipes, the company's general counsel, "there were outbreaks from time to time. Now there are none."

Light Signatures contends that just putting a system into operation often helps. "For some reason, when they [counterfeiters] know we can spot them, they stop doing it," says Paul Luxion, Light Signatures' director of government systems.

All anticounterfeiting systems do basically the same thing: label a product so you can tell it's authentic. The difference among the systems lies in *how* they do it. Most of the methods were developed as spinoffs of technologies already in existence at large corporations.

This is the case with the tag in Allied Corp.'s TruTag system, described in the beginning of this article. A manufacturer can simply include one of the coin-sized discs in each unit he wants to be able to identify later. Such a tag could be sewed up inside a doll, for example, sealed in a small bottle of prescription drugs, or molded into a piece of plastic in almost anything.

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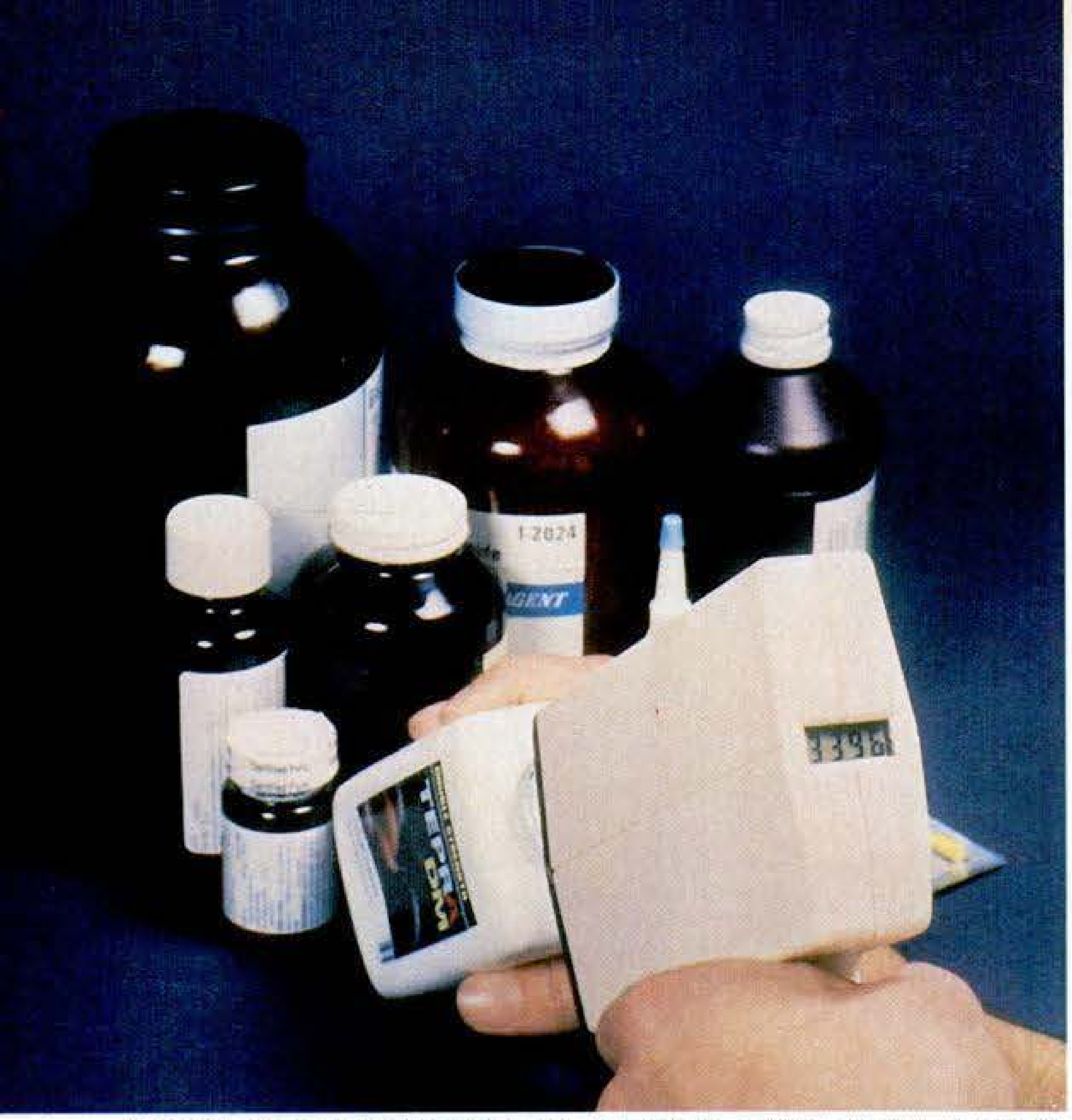
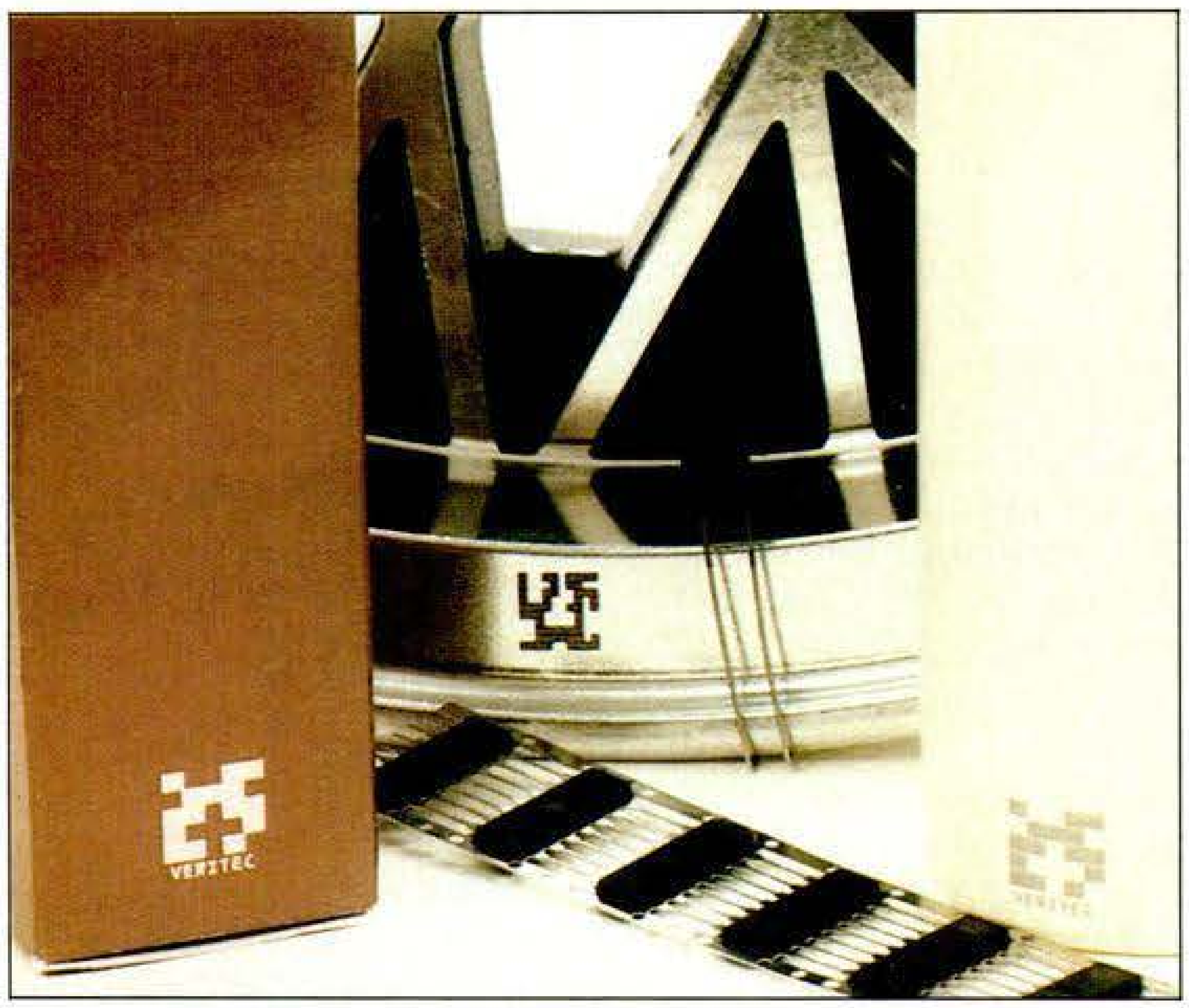


On-the-spot verification is possible with Allied Corp.'s TruTag system. The 1-lb. scanner excites a coded metal tag, and the number shows that the product is authentic.



Vericodes, which may be "the bar codes of the future," are applied to products by ink or laser etching. The coded blocks can be made as small as a fraction of an inch.

The TruTag system evolved from research the company had been doing for years. "The system is a spinoff of metallurgical research," said Allied's Johnson. "It took ten years and a hundred million dollars to develop."

Company officers are cagey about the nature of the tag but Johnson provided some information. "The metal the tag of is made is the key to the system," he said. "It's an exclusive alloy, a synthetic metal that's not found in nature. It's difficult to make—an involved process. We can barely make it ourselves."

To see whether an item is genuine, you hold the handgun-like scanner next to the item and press the trigger. The device generates a low-frequency (below 100 kilohertz) electromagnetic signal. A genuine tag inside the object will be activated in a method the company won't describe, and will return a signal to the scanner. Each tag can be coded with a four-digit number. If the microprocessor in the scanner detects a genuine signal, the number appears on the display. If it doesn't, the item is phony.

So secretive are the companies in the business that Allied won't say who uses the system. "Our customers don't want us to tell their name or industry," says Johnson.

Not all anticounterfeiting systems require high-tech detectors or analyzers. Many require only the detector we all have: the human eye. Some of these systems have existed for many years. For example, American Bank Note Co. has been printing currency since 1795. Today it prints money for 74 foreign countries, along with a wide variety of documents and securities that must resist counterfeiting. The company has developed a variety of methods of protection, including ultra-small microprinting—hard to duplicate—and a method of printing letters so they're visible only at certain angles—a process called Latent Image.

About five years ago, ABN acquired the technology and exclusive rights for putting holograms on documents for security purposes. It's a highly complex process that requires expensive equipment. A hologram is created by reflecting laser light off an object onto a photographic plate. The laser beam is split, with half the beam going directly onto the plate and the other half reflected by a mirror, through a lens to the object, and then onto the plate. The plate records the light-interference pattern of the two beams, creating a three-dimensional image. High-powered lasers, precision optics and alignment devices, and ultra-stable tables are needed to generate a quality hologram. ABN's holograms are made in a dust-free laboratory in which temperature and humidity are precisely controlled. Plates are coated with an almost grainless gel ABN developed to produce extremely fine-lined images ["Holography—Out of the Lab at Last," PS, March '84].

Once the master image is made, the holograms are re-

[*Continued on page 125*]

REDUCED
MONTHLY PASS
RTD
THORN EMI
VIDEO

A roll of shimmering Polaproof labels (above left), which are thin polyester sandwiches of tiny lenses and colored lines, are shown on two of the products they protect: an L.A. Rapid Transit pass (center) and a Thorn-EMI video package (right). The labels' unique optical effects are destroyed if the labels are tampered with or removed.

All-out computer car

The Eltec, European Ford's auto-electronics test-bed, sports an array of computer-controlled features that includes everything from an electronically optimized engine to a sun roof that shuts itself when it rains.

Slippery-bodied Ford Eltec employs microprocessors to control engine performance and cooling, transmission ratios, wheelspin, suspension, and even a louvered sun roof that shuts at the first drop of rain. Dashboard (above) adjusts with the steering column for better vision through the wheel. Note the use of gauges rather than electronic displays.

By DAVID SCOTT

Europe's latest automotive research vehicle, Ford's Eltec, is really in the chips... computer chips, that is. Short for Electronic Technology, the Eltec's British, German, and Italian designers seem to have made a special effort to cram in every microprocessor-regulated device they could fit under its slippery, aerodynamic body.

The Eltec's microchip-controlled power plant—an experimental 1.3-liter, 80-hp overhead-cam four—uses fuel injection and is said to give the Escort-size car about 42 mpg in city driving. Each lean-burning cylinder has three valves (two inlet, one exhaust).

Ford's EEC-IV central microprocessor controls sliding induction manifold inlet pipes that lengthen to provide good low-speed torque and shorten to give maximum power at higher speeds. Combustion is further enhanced by automatic selection of dual air-intake ports in the cylinder head. One port closes at low speeds or medium loads, when high charge velocities boost combustion efficiency, and opens only when higher fuel flow is needed at full power. A microcomputer also optimizes fuel delivery and ignition timing in each cylinder.

Even engine cooling is regulated by the Eltec's electronics. The water, which is largely in the cylinder head, is pumped from the radiator at a speed determined by a computer that monitors water temperature. Twin electric fans are controlled in the same way. This arrangement makes the radiator 30 percent smaller than the Escort's so that it fits in a duct below the bumper. The cooling system permits the engine to reach normal running temperature rapidly, cutting fuel use and emissions.

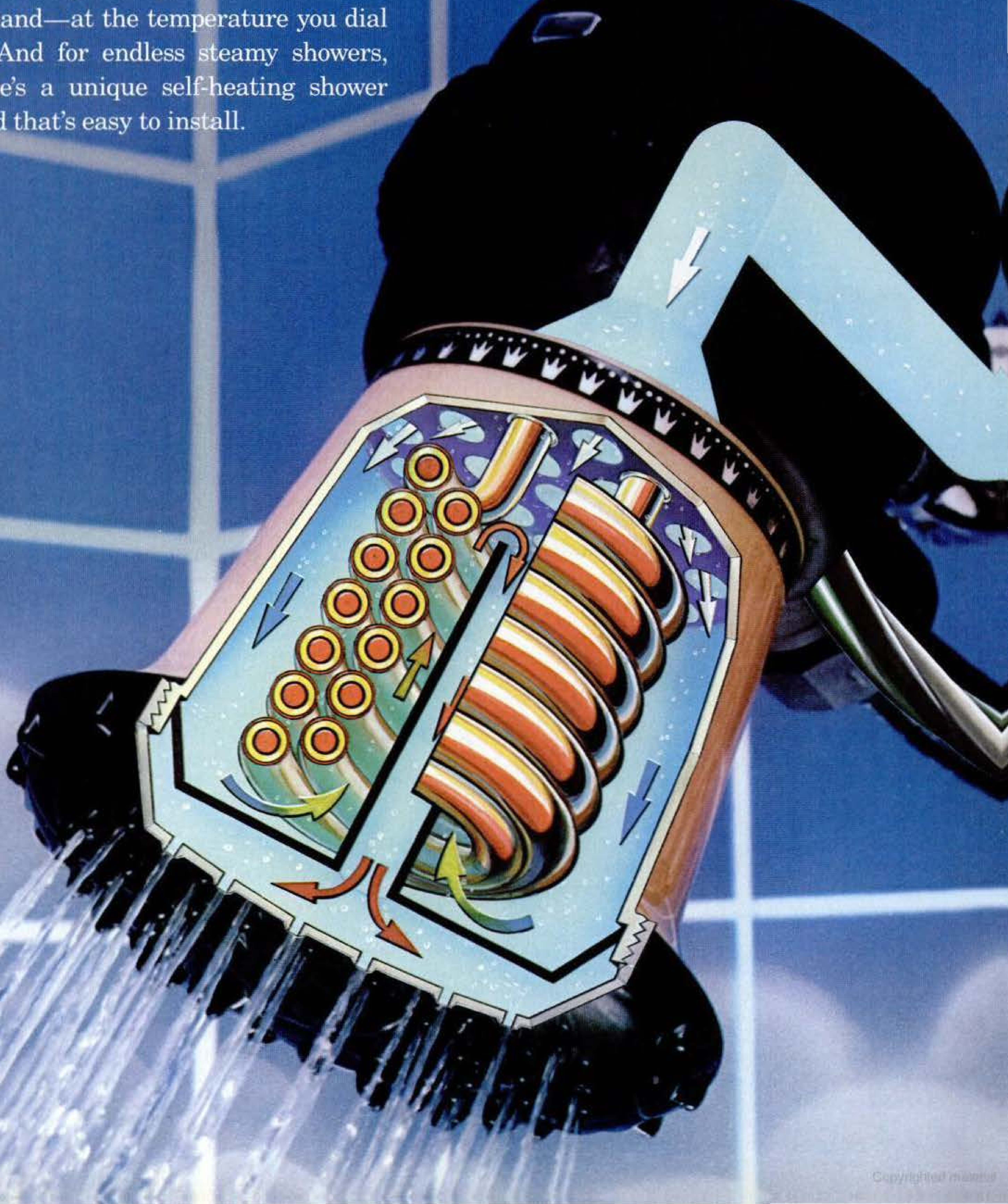
The research car's electronic throttle control ties in with its anti-wheelspin and four-wheel anti-lock braking systems. Sensors measure the rotational speed of the driven front wheels. If a wheel starts to spin too rapidly, the computer alerts a servomotor to back off the throttle and simultaneously triggers another servo to increase braking pressure on that wheel.

The transmission is Ford's continuously variable CTX. This belt-and-pulley unit adjusts to satisfy the driver's demands at the most efficient engine speed. It has two drive modes—Economy and Power—which vary the programmed stepless ratio changes.

The Eltec's suspension system also received the electronic treatment. Computers control auxiliary air springs to vary handling characteristics, as well as ride height, according to load and driving conditions.

Never-ending hot water—and energy savings, too

Now tankless water heaters make it even easier to cut energy bills. New modulating units provide hot water on demand—at the temperature you dial in. And for endless steamy showers, there's a unique self-heating shower head that's easy to install.



By RICHARD LAYNE

What I like best about my hot-water heater is that it works all the time—even when I'm out for the evening or loafing around the house. A storage heater's devotion to duty, however, is not without its price.

In a home, a storage tank is second only to a space heater in its appetite for energy. To keep 50 gallons of water hot 24 hours a day—during which time the average family draws less than an hour of hot water—typically costs about $200 for gas and $450 for electricity annually. Worse, a quarter of that is wasted in standby losses, the dissipation of heat through the tank's jacket.

Ready to dump your storage heater? Now there's another route to hot water: tankless water heaters. Hook up an electric or gas (liquefied-propane models are available) unit to your hot-water line, turn on a faucet, and you'll get a never-ending supply of hot water—instantaneously. As soon as water enters the heater, flow sensors switch on the gas burners or copper heating coils. The generated heat is absorbed by the water, and the temperature boost can reach 90 degrees F. Shut off the faucet, and you turn off the heater.

You can use tankless heaters in several ways. You can substitute a powerful tankless unit—or a series of smaller units—for a storage heater. New modulating units even let you set the heated water's temperature. (These models also make an ideal complement to solar-heated hot-water systems—what the sun can't do, the heaters can.) Or you can turn down the tank's thermostat and supplement it with a point-of-use heater for the dishwasher. You can also install a self-heating shower head that connects to the cold-water line (see the cutaway on the opposite page). In any case, you'll cut your hot-water heating bill and save your pipes and tank from corrosion caused by water heated to greater than 120 degrees.

Wasted energy isn't the only reason for giving your storage tank the heave-ho: Water temperature is another. Most storage-tank heaters maintain water between 150 degrees and 180 degrees—too hot for anything but a dishwasher, which requires water at 140 degrees. Showers run about 105 degrees and hand washing about 98 degrees, so for these you have to mix in cool water to bring down the temperature. That's energy wasted. "Why should a dishwasher dictate bath-water temperature?" asks Robert Russell, of Chronomite Laboratories.

Capacity is a hot-water tank's only saving grace—it can supply a shower, a dishwasher, and a couple of faucets simultaneously. Once drained, however, it's slow to recover. A 50-gallon gas heater takes an hour to refill its supply of 150-degree water, and an electric heater takes two hours.

With a tankless heater, you can adjust the water temperature to suit the task. At the heart of a tankless heater is a heat-transfer mechanism. Ground water, usually at 50 degrees, enters the unit and trips a flow sensor. If the flow is high enough—most models require about ½ gallon per minute (gpm) for activation—a sensor turns on the burners or water-immersed copper heating coils, and the heat is transferred to the water. As long as the faucet stays open, the heater fires up the water—endlessly.

The first tankless heaters available in the United States (they've been standard in Europe for the past 70 years) were fixed-heat-output models ["Tankless Water Heaters," PS, Feb. '82]. These were designed to always deliver their full complement of heat to the circulating water when you turned on the faucet.

In these models, the higher the water-flow rate, the cooler the exiting water. Reduce the flow, and the

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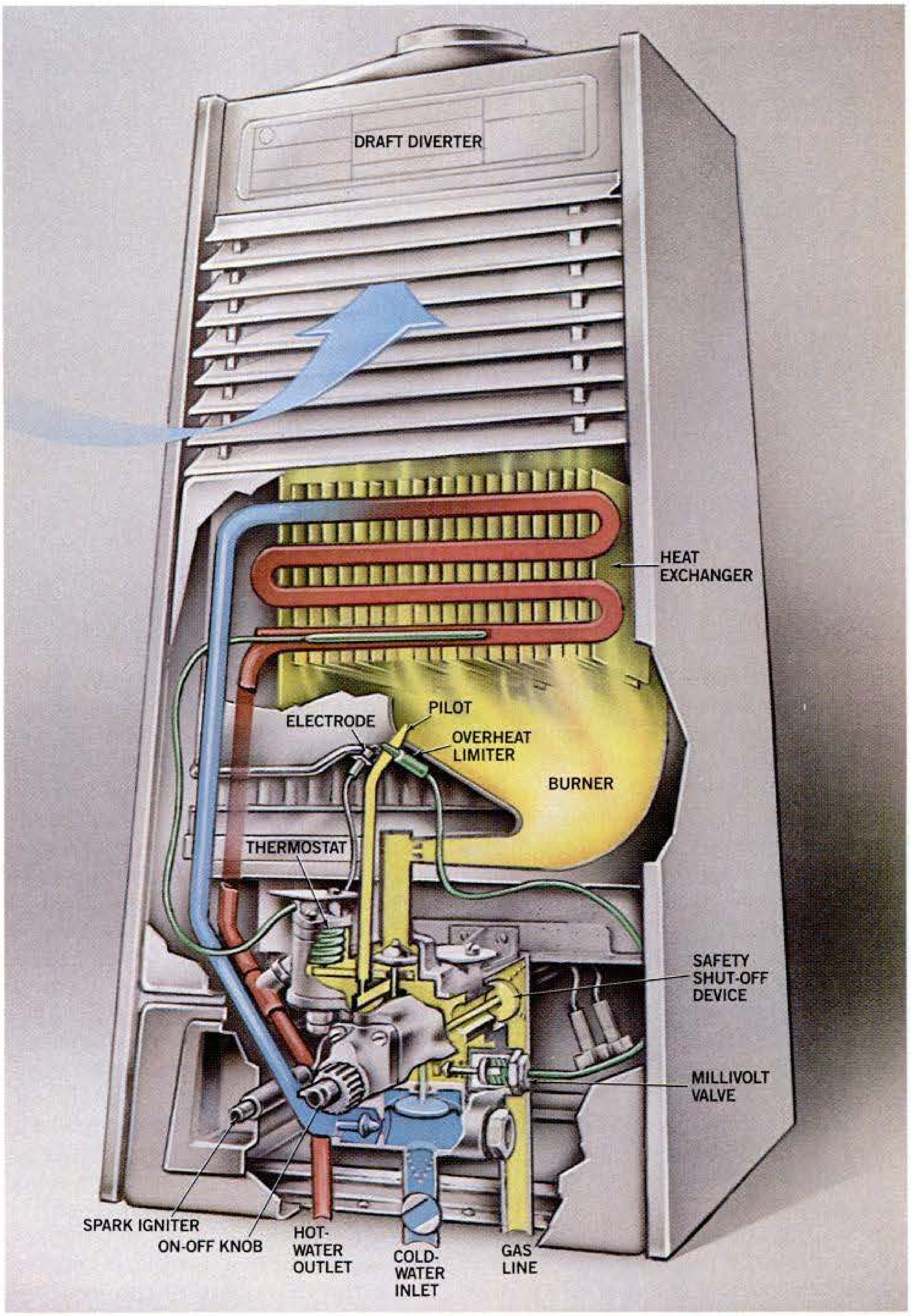


In a gas tankless heater, water absorbs heat as it snakes around the heat exchanger. New modulating units feature a thermostatic gas valve that adjusts the gas flow to the burners to keep water at a set temperature. In an electric self-heating shower head (opposite page), cool water runs along copper heating coils, rises to the mouth of a flow-limiting tube, and exits.

PS sampling of tankless water heaters

Fixed-output heaters

	Manufacturer or distributor	Model	Temp. rise (°F) @ flow rate (gpm)	Max. heat input	Start-up/shut-off flow rate (gpm)	Price ($)	Comments
Electric	Chronomite Laboratories 21011 S. Figueroa Carson CA 90745	Instant-Flow S-60C	30 @ 1.50	6.0 kW	1.0/0.65	185	Booster units work with storage tank set at 110°; S-60C is a dishwasher booster; S-90I hooks to cold-water line; flow control limits rate to 1 gpm
		Instant-Flow S-90I	61 @ 1.00	9.0 kW	1.0/0.65	185	
		Instant-Flow S-30L	40 @ 0.50	3.0 kW	0.40/0.30	185	
	Pecbras Co. 1300 Stirling Rd. Suite 4 Dania FL 33004	Corona CTH-40	58 @ 1.00 38 @ 1.50	8.4 kW	0.55/0.50	189	Lower-powered shower head also available for RV use
		Corona CHS-40 (self-heating shower head		8.4 kW	0.50/0.50	120	
Gas	International Technology Sales Corp. 7450-E E. Jewell Ave. Denver CO 90231	Fastomatic Maxitask V300	90 @ 1.48 52 @ 2.50	85,000 Btu/h	0.25/0.25	435	Available for liquid propane gas; equipped with piezoelectric ignitor; can be used with single lever and temperature-controlled faucet
		Fastomatic Multitask V450	90 @ 2.26 58 @ 3.50	132,000 Btu/h	0.50/0.50	565	
	Saunier Duval 7 Odell Plaza Yonkers NY 10701	Aquavac SD42	90 @ 2.10 80 @ 2.35 60 @ 3.15 40 @ 4.74 30 @ 6.33	117,000 Btu/h	0.66/0.66	599	Porcelain finished; liquid-propane models available

Modulating heaters

	Manufacturer or distributor	Model	Temp. rise (°F) @ flow rate (gpm)	Max. heat input	Start-up/shut-off flow rate (gpm)	Price ($)	Comments
Electric	Acutemp Corp. Box 8115 Ann Arbor MI 48107	144	95 @ 1.00 51 @ 2.00 23 @ 4.00	240 V/14.4 kW	0.50/0.35	500	Temperature-rise settings between 40° and 120° on heater or remote thermostat; small booster units (9.6 kW and 4.8 kW) available
		180	120 @ 1.00 63 @ 2.00 30 @ 4.00	240 V/18.0 kW	0.50/0.35	530	
	Thermar Corp. Thermar Ctr. Trumbull CT 06611-0398	Super Power Pack 7kW	90 @ 0.75	240 V/9.0 kW	0.50/0.50	248	Set between 100° and 145°; automatic cutoff above 150°; hooked in series, heaters yield 90° rise at higher flow rates
		Super Power Pack 9kW	30 @ 0.20	240 V/7.0 kW	0.50/0.50	248	
Gas	Paloma Industries 241 James St. Bensenville IL 60106	PH-12MD	100 @ 0.48-1.43 90 @ 1.59	89,300 Btu/h (max.) 30,000 Btu/h (min.)	0.48/0.48	550	Adjustable setting for temperature rise between 60° and 100°
		PH-16MD	100 @ 0.48-1.90	121,500 Btu/h (max.) 30,000 Btu/h (min.)	0.48/0.48	695	
	Thermar Corp. (see above)	Homemaster Deluxe	90 @ 0.8-1.60 80 @ 0.8-1.90	100,000 Btu/h (max.) 30,000 Btu/h (min.)	0.50/0.50	499	Also comes directly vented; temperature-rise settings between 40° and 100° on heater or remote thermostat
	Controlled Energy Corp. Fiddler's Green Waitsfield VT 05673	AquaStar AS80	90 @ 1.30 45 @ 2.60	77,500 Btu/h (max.) 25,000 Btu/h (min.)	0.75/0.60	450	Set dial at 110° to 150°; automatic shut-off at 185°; push-button piezoelectric ignitor
		AquaStar AS125	90 @ 2.11 45 @ 4.22	125,000 Btu/h (max.) 44,000 Btu/h (min.)	0.75/0.60	599	

set amount of heat has more time to permeate the slower-moving water. At a 1-gpm draw, typical of a bathroom faucet, a heater will boost water temperature as much as 90 degrees. You've got to blend in cold water to suit. Increase the demand, either for a dishwasher fill (1.5 gpm) or a low-flow shower (2 gpm), and the water temperature nose-dives.

New modulating heaters (see illustration) ignore flow rate—to an extent. They can limit the heat input, so you can set the exiting water's temperature. Dial in an outlet water temperature of 130 degrees, for example, and that's what you'll get—up to about 2 gpm of water flow.

"Modulating heaters can turn the heat supply down, not up," says Steven Steiner, an engineer at Thermar. "A thermostatic sensor at the bottom of the heat exchanger controls a bellows. This alters the pressure on the diaphragm valve controlling the gas. If the water is getting too hot, the sensor will alert the bellows to cut down the gas. The gas supply can be restricted, but it can't be increased."

In Thermar's Homemaster Deluxe, for example, you can reportedly get an 80-degree temperature rise for 1.9-gpm flow. Halve the flow, and the diaphragm valve will cut the gas flow to supply the same temperature rise. Raise the flow above 2 gpm, and the unit acts like a fixed-output heater: The burners open up completely, and flow rate again governs temperature.

"The bonus of a modulating unit is that you don't have to wait until you're drawing water at two gallons per minute or more to get low-temperature water," says Pierre Moffroid, president of Controlled Energy Corp.

Energy saving varies, depending on the installation. You could save more by replacing a storage tank with a tankless heater than by keeping the tank and using a tankless booster. While tankless heaters can be more expensive than storage models (see table), which range in price from $100 to $400, payback can be fast.

The Department of Energy figures that a family of four uses 64.3 gallons of hot water a day. For 48- to 55-gallon gas heaters, the operating cost typically runs between $176 and $266; electric, $406 to $526.

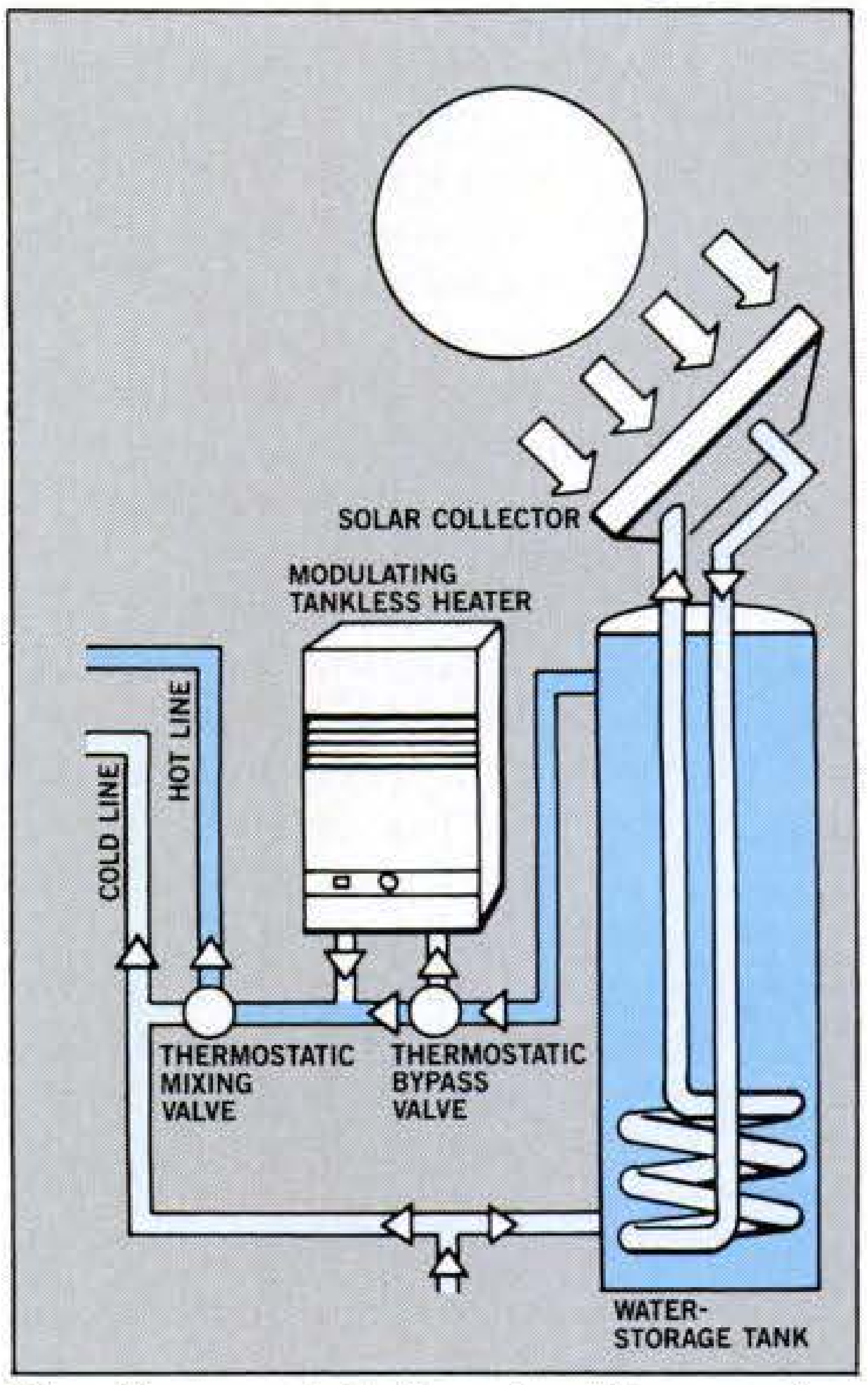
Where there's no storage, there can be no standby loss, which is usually 25 percent of the hot-water heating cost. "Tankless heaters save energy by not having standby losses," says James E. Harris, a National Bureau of Standards engineer who has been studying tankless heaters. "And they don't have any flue losses, which gas-fired storage heaters do."

What they do have are pilot lights, which Harris estimates cost about 10 cents a day to run. Some models feature push-button piezoelectric ignitors, which make turning on the pilot easy.

Manufacturers' claims for annual savings vary widely: from $104 for switching from a gas storage heater to a gas tankless heater, climbing to almost $800 for installing an electric tankless heater (or a series of small units) in place of an electric storage tank. No independent laboratory has published a study. One way to estimate possible savings is to trace the calculations of Thermar engineers, who figure an annual saving of $258 for gas and $210 for electric. Here's how they arrived at those numbers:

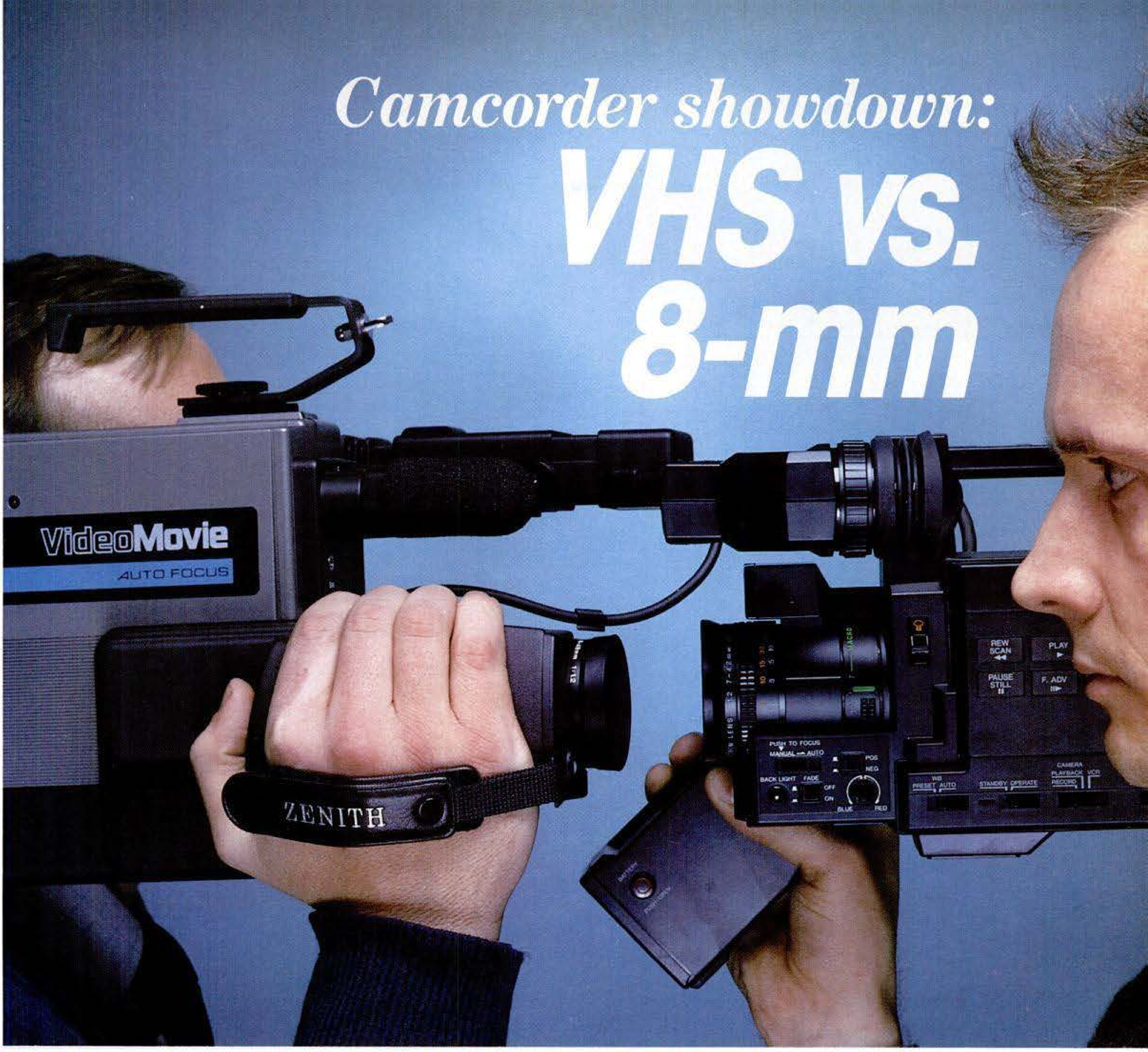
At 80 cents a therm, a 50-gallon gas heater costs $1.18 a day to run, ac-

[Continued on page 150]


SOLAR COLLECTOR
MODULATING TANKLESS HEATER
COLD LINE
HOT LINE
THERMOSTATIC MIXING VALVE
THERMOSTATIC BYPASS VALVE
WATER-STORAGE TANK

For the modulating tankless water heater in a solar-heating installation, two valves are required. The bypass valve diverts solar water that's hot enough away from the tankless unit, which would add an unnecessary jolt of heat. The mixing valve slows down the hot-water flow and supplements it with cold water from the supply line.

Camcorder showdown: VHS vs. 8-mm



Camcorder sales are soaring, and manufacturers are scrambling to design new lightweight, easy-to-use models that create high-quality pictures. But VHS-C and Beta could be tape formats of the past: The newest units use VHS or 8-mm tape. Which system is better?

By WILLIAM J. HAWKINS
Photos by Greg Sharko

Aim and pull the trigger: The result is instant home movies on videotape. That's the promise of camcorders, those all-in-one units that combine a video camera with a videocassette recorder in a single easy-to-handle package. But determining which model to buy isn't easy because there are competing camcorder formats.

"The battle lines appear to be forming between VHS and a new generation of eight-millimeter machines," says Bob Ridell, General Electric Co.'s marketing manager of audio-video products. Once considered too bulky or too low in picture quality to compete against Beta or VHS-C (a half-size VHS cassette that holds 20 minutes of tape and requires an adapter to be played on a VHS home deck), full-size VHS and 8-mm are the two most common formats, offered by nearly every camcorder maker. What happened?

Full-size-VHS camcorders have become smaller and lighter, and 8-mm models, spearheaded by Sony's introduction [PS, Sept. '85], now produce exceptionally good pictures. To find out how all that was done, I tested models in each format. I also spoke to engineers and makers of both 8-mm and VHS camcorders. I was surprised to learn that despite the format differences, the principal technical change made in these units is head design. But the effects have been dramatically different in each machine. And making a choice between them is now extremely difficult.

Shades of Shakespeare

"Try it yourself," said Tom Rice, department head of Eastman Kodak Co.'s motion-video department, as he handed me the company's new 8-mm

Continued

PS sampling of camcorders

Brand	Model	Price ($)	Format	Weight (lb., w/ batt. & tape)	Dimensions (in.)	Lens	Imager type	Record time (hr.)		Recording horizontal resolution (lines)	Minimum illumination (lux)	Viewfinder type, size (in.)	Insert edit	Playback	Autofocus	Fast-scan search	Auto. iris	Auto. white bal.	Backlight compensation	Fade control	Stereo ready
								Per battery	Tape												
Aiwa	CV-80	n.a.*	8-mm	5.1	4½ × 7½ × 13½	12–72 mm, f/1.4, 6× zoom	CCD	1	2	240	19	EV; 1	●	●	●	●	●	●	●	●	
Canon	VM-E1	1,600	8-mm	5.0	5⅝ × 5⅞ × 13⅛	8.5–51 mm, f/1.2, 6× zoom	Saticon, ½"	1½	2	300	19	EV; 0.7			●	●	●	●	●	●	
Curtis Mathes	MV800	1,800	VHS	7.7	6.1 × 7.6 × 13.8	9–54 mm, f/1.2 6× power zoom	Newvicon, ½"	2½	2	230	10	EV; ½	●	●	●	●	●	●	●	●	●
Elmo	ECR-600AF	1,850	VHS	7.7	6⅛ × 7 9/16 × 12 13/16	9–54 mm, f/1.4, 6× zoom	Newvicon, ½"	2	2⅔	240	10	EV; ½		●	●	●	●	●	●	●	
General Electric	ICVM5080	1,239	8-mm	6.5	5.9 × 6.4 × 13.0	10–60mm, f/1.2, 6× power zoom	Newvicon, ⅓"	⅔	1½	260	20	EV; ½		●	●	●	●	●	●	●	
	ICVM5060	1,999	VHS	8.0	6.1 × 7.8 × 13.8	9–54 mm, f/1.2, 6× power zoom	Newvicon, ½"	2	2⅔	270	10	EV; ½		●	●	●	●	●	●		
Hitachi	Cam 'n Cord VM 2000	1,499	VHS	6.2	6½ × 7⅜ × 14	8.5–51 mm, f/1.2, 6× zoom	Saticon, ½"	1	2⅔,	300	7	EV; ⅔		●	●	●	●	●			
JCPenney	5330	1,599	VHS	7.7	6½ × 7½ × 13¾	9–54 mm, f/1.2, 6× power zoom	Newvicon, ½"	2	2⅔	525	10	EV; ½		●	●	●	●	●	●		
JVC**	GR-C2	1,650	VHS-C	4.8	5 5/16 × 6 × 13 7/16	8–48 mm, f/1.2, 6× power zoom	Newvicon, ½"	1	⅓	230	15	EV; 0.7	●	●	●	●	●	●	●	●	
Kodak	MVS-440	1,700	8-mm	approx. 4.5	3.3 × 9.4 × 15.0	9–54 mn, f/1.2, 6× power zoom	Newvicon, ½"	1	2	280	10	EV; ½		●	●		●	●	●	●	●
	MVS-460	2,000	8-mm	approx. 4.5	3.3 × 9.4 × 15.0	9–54 mm, f/1.2, 6× power zoom	Newvicon, ½"	1	2	280	10	EV; ½		●	●	●	●	●	●	●	●
Kyocera	Finemovie 8	1,745	8-mm	5.8	5 × 7⅝ × 13⅞	12–72 mm, f/1.4, 6× power zoom	CCD	1	2	330	19	EV; 1	●	●		●	●	●	●		●
Magnavox	VR82905L	1,799	VHS	7.7	6 × 7½ × 13¾	10–60 mm, f/1.2, 6× power zoom	Newvicon, ½"	2	2⅔	230	10	EV; ½		●	●	●	●	●	●	●	
Matsushita	PV-200	1,650	VHS	7.7	6⅛ × 7½ × 13¾	9–54 mm, f/1.2, 6× power zoom	Newvicon, ½"	2	2⅔	230	10	EV; ½		●	●	●	●	●	●		
Minolta	CR-1000S	1,833	VHS	5.5	6 7/16 × 7 7/16 × 13 15/16	8.5–51 mm, f/1.2, 6× power zoom	Saticon, ½"	2⅔	2⅔	300	7	EV; ⅔		●		●	●	●	●		
NEC	VM55EU	1,495	Beta	6.7	5¾ × 6 15/16 × 14¾	12–72 mm, f/1.4, 6× power zoom	CCD	1	3⅓	n.a.	25	Optical	●	●	●	●	●	●			
	VIOU	1,695	VHS	7.2	6 3/32 × 7 9/16 × 12¾	9–54 mm, f/1.4, 6× power zoom	Newvicon, ½"	1	2⅔	n.a.	10	EV; ½				●		●			
Olympus	VX-402	1,850	VHS	7.3	6.2 × 7.7 × 13.0	9–54 mm, f/1.4, 6× power zoom	Newvicon, ½"	2	2⅔	n.a.	10	EV; ½		●	●	●	●	●		●	
Panasonic	PV-200	1,650	VHS	7.7	6⅛ × 7½ × 13¾	9–54 mm, f/1.2, 6× auto zoom	Newvicon, ½"	2	2⅔	240	10	EV; ½		●	●	●	●	●	●		
Pentax	PV-C11A	1,699	VHS	6.5	6 7/16 × 7 7/16 × 13 15/16	8.5–51 mm, f/1.2, 6× power zoom	Saticon, ½"	1	2⅔	300	7	EV; ⅔		●		●	●	●			
Philco	VCR800SL	1,699	VHS	7.7	6 × 7½ × 13¾	10–60 mm, f/1.2, 6× power zoom	Newvicon, ½"	2	2⅔	230	10	EV; ½		●	●	●	●	●	●	●	
Quasar	VM-10	1,699	VHS	7.7	6⅛ × 7½ × 13¾	9–54 mm, f/1.2, 6× power zoom	Newvicon, ½"	2	2⅔	260	10	EV; ½		●	●	●	●	●	●		
RCA	CLR200 ProWonder	1,400	VHS	7.0	6 7/16 × 7 7/16 × 13 15/16	8.5–51 mm, f/1.2, 6× power zoom	Saticon, ½"	1	2⅔	n.a.	7	EV; ⅔		●	●	●	●	●	●		
Sanyo	VRC500	1,195	Beta	6.5	5¾ × 7 × 14¾	12–72 mm, f/1.4, 6× power zoom	CCD	1	2	n.a.	25	EV; 1				●	●	●			
	VM8	1,750	8-mm	6.0	5 × 7¼ × 13¾	12–72 mm, f/1.4, 6× power zoom	CCD	1	2	n.a.	19	EV; 1		●	●	●	●	●			
Sears	LXI	1,290	VHS	6.3	n.a.	n.a., f/1.2, 6× power zoom	Saticon, ½"	1	2⅔	300	7	EV; ⅔		●	●	●	●	●			
Sharp	VC-C10UA	1,899	VHS	6.5	6¼ × 7 9/16 × 13⅜	n.a., f/1.4, 6× power zoom	Newvicon, ½"	2	2⅔	240	10	EV; ½		●	●	●	●	●	●		
Sony	BMC660K	1,495	Beta	6.3	5¾ × 7 × 14¼	12–72 mm, f/1.4, 6× power zoom	CCD	1½	½	n.a.	25	EV; 1				●	●	●			
	CCD-V8AFU	1,745	8-mm	6.0	5 × 7⅝ × 13⅞	12–72mm, f/1.4-1.7, 6× power zoom	CCD	1⅓	2	300+	19	EV; 1	●	●	●	●	●	●	●		
	CCD-M8U	1,795	8-mm	3.0	4¼ × 4¼ × 8½	15 mm, f/1.6	CCD	1⅓	2	250	19	Optical		●	●	●	●				
Sylvania	5CC150SL	1,799	VHS	7.7	6 × 7½ × 13¾	10–60 mm, f/1.2, 6× power zoom	Newvicon, ½"	2	2⅔	230	10	EV; ½		●	●	●	●	●	●		
Zenith	VM6000	n.a.	VHS-C	5.3	4 5/16 × 5⅜ × 12⅜ (excl. v.f. & battery pack)	8–48 mm, f/1.2, 6× power zoom	Saticon, ½"	¾	⅓	230	15	EV; ½		●	●	●	●	●	●	●	
	VM6100	n.a.	VHS-C	5.6	4⅞ × 5⅜ × 12½ (excl. v.f. & battery pack)	8–48 mm, f/1.2, 6× power zoom	Saticon, ½"	¾	⅓	230	15	EV; 0.7		●	●	●	●	●	●	●	
	VM7000	n.a.	VHS	7.0	6 1/16 × 7 5/16 × 14⅛ (excl. v.f. & battery pack)	8–48 mm, f/1.2, 6× power zoom	Saticon, ½"	1½	2⅔	240	15	EV; 0.7		●	●	●	●	●	●	●	

* n.a., not available; **JVC will have a special 1-hr. VHS-C model shortly

MVS camcorder at a recent New York demonstration. Rice pointed to a group of performers in front of us: seven Shakespearean dancers dressed in 17th-century clothing, complete with instruments of the era. As they danced and sang, I pressed the camcorder's "Record" button.

Using the camera was a snap. I could zoom in on the shot, fade in and out of the scene, or vary intensity with only minor movements of my fingers.

Most recording controls are under the fingers of the right hand, so I could find them quickly and easily by feel. At the moment, however, the most important control to me—after 10 minutes of 17th-century music—was the "Stop" button.

Rice then connected the camcorder to an audio-video system for playback, and the colorfully clad performers I taped served as a convincing display of the recording system's quality: Color, brightness, and sharpness were excellent, not at all like the poor images I'd seen from early 8-mm camcorders.

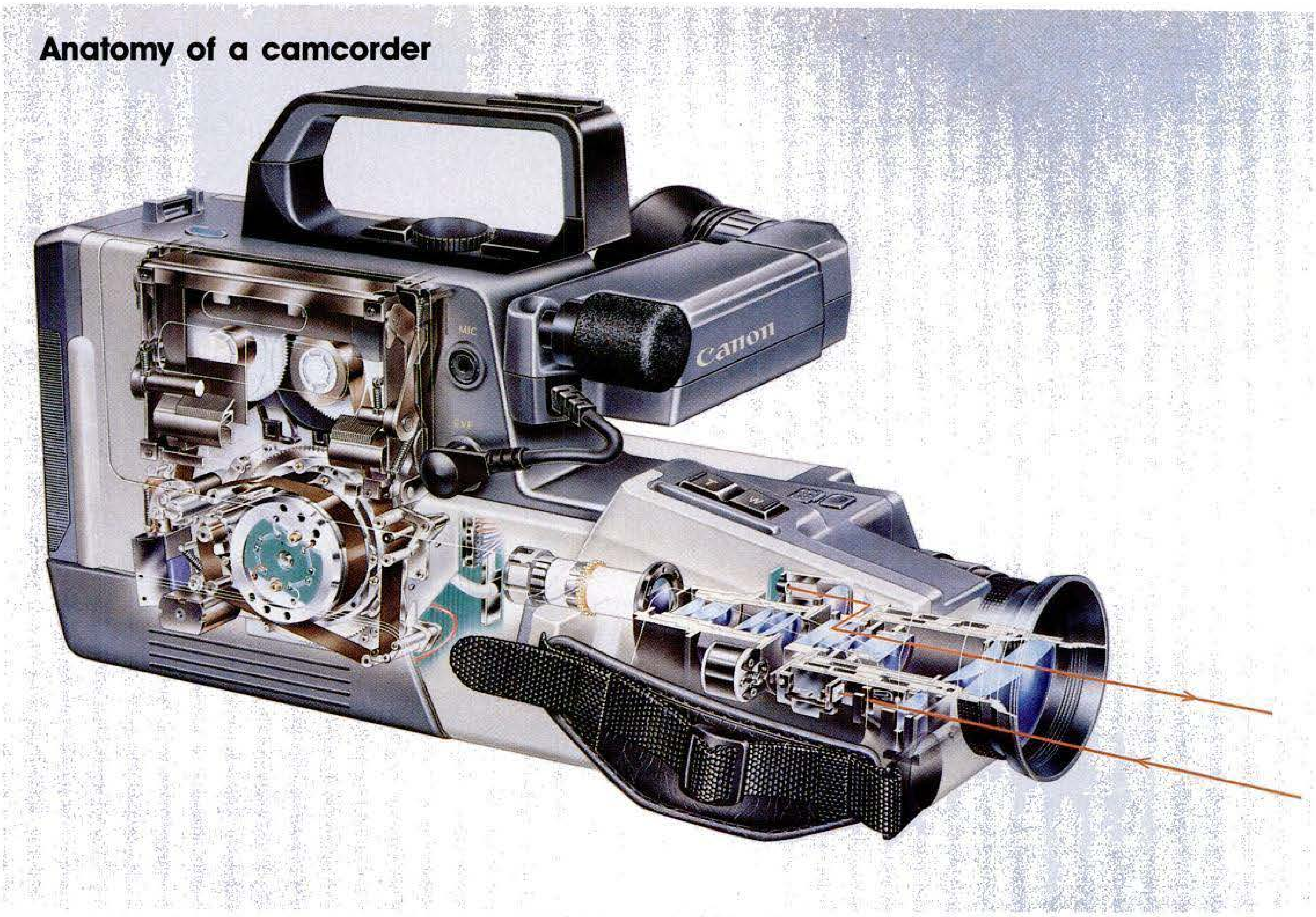
"Eight-millimeter camcorders had the built-in advantage of small size," said Rice. "But it wasn't easy getting that image quality. It meant beating a lot of problems." He then stopped the tape, ejected the cassette, and held it up. "Particularly this one."

The 8-mm cassette is small, just slightly larger than an audio cassette. The quality of a video recording depends on the amount of information stored on a tape. More storage can be obtained by increasing the width of the tape (something an 8-mm designer would be loath to do), or by increasing tape speed so information can be spread down the tape. But that would result in an unacceptable loss in recording time. The alternative cure, to pack a denser video signal on the cassette, was more difficult.

"First we had to change from the usual oxide formulation to an all-new metal-particle tape," said Rice. "It's virtually pure iron held in place with a binder." Because of the high iron concentration, information can be packed much tighter for a better recorded signal. Even assuming that creating a flexible iron tape was easy, that caused another problem. "It could rust," Rice said. "So the final formulation had to be specially treated to protect the tape from oxidizing in use."

To use the tape, new recording heads were required. "The original heads were ferrite," Rice told me. "The new eight-millimeter gear uses amorphous heads, which accept much higher recording currents." With these, a stronger signal is recorded, so there is less

Anatomy of a camcorder



Little space is wasted in this 8-mm Canon camcorder, a careful blend of intricate optics and electronics.

video noise, or snow, particularly on a color image.

"We're not talking about a simple off-the-shelf replacement of heads," added Rice. "With everything smaller, all manufacturing tolerances become much tighter. Tracking accuracy has to be within one or two microns. That's like two wavelengths of light. Doing it in the lab is one thing; doing it in millions of production units is quite another."

Although picture quality is most important in a camcorder, 8-mm backers are stressing that audio reproduction should also be considered. Rice replaced my videotape with another and again pressed the "Play" button. No image appeared on the screen, but the speakers thundered, filling the room with music.

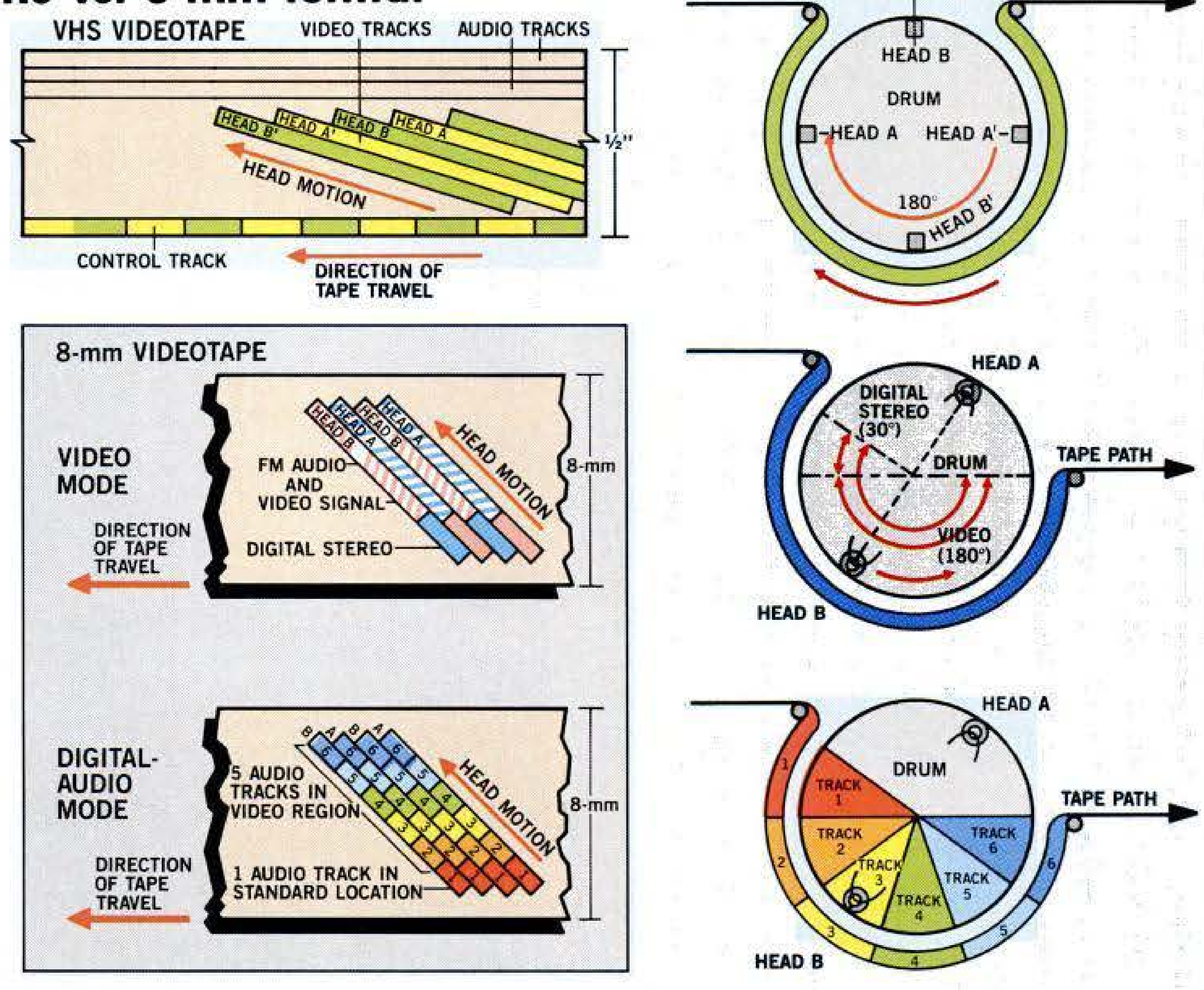
"That's a stereo digital recording," said Rice. "Besides video recording, eight-millimeter systems are capable of being used as a digital audio tape recorder, and each cassette holds up to twelve hours of music. Try that on a VHS machine."

VHS compatibility

"We're appealing to people who are comfortable with VCRs," says Bruce

[Continued on page 140]

VHS vs. 8-mm format


VHS VIDEOTAPE
VIDEO TRACKS
AUDIO TRACKS
HEAD B'
HEAD A'
HEAD B
HEAD A
HEAD MOTION
½"
CONTROL TRACK
DIRECTION OF TAPE TRAVEL
TAPE PATH
HEAD B
DRUM
HEAD A
HEAD A'
180°
HEAD B'
8-mm VIDEOTAPE
VIDEO MODE
FM AUDIO AND VIDEO SIGNAL
DIGITAL STEREO
HEAD B
HEAD A
HEAD B
HEAD A
HEAD MOTION
8-mm
DIRECTION OF TAPE TRAVEL
HEAD A
DIGITAL STEREO (30°)
DRUM
TAPE PATH
VIDEO (180°)
HEAD B
DIGITAL-AUDIO MODE
5 AUDIO TRACKS IN VIDEO REGION
1 AUDIO TRACK IN STANDARD LOCATION
HEAD MOTION
8-mm
DIRECTION OF TAPE TRAVEL
HEAD A
DRUM
TRACK 1
TRACK 2
TRACK 3
TRACK 4
TRACK 5
TRACK 6
TAPE PATH
HEAD B

VHS and 8-mm camcorders use a spinning head drum to record video on helical tracks. For audio, VHS uses a separate head. In video mode, 8-mm records a single audio channel mixed with the video; one-sixth of the video track is for digital stereo. In audio mode, all tracks are for digital stereo.

Beginning here . . . Spring Home Improvement

This annual special section usually focuses on outdoor projects like the one below. But early spring is also a time for sprucing up your home's interior, after the winter blahs. So here's a 13-page cluster of features to keep you busy indoors and out.

Two-phase inside-out sun deck

By PHIL McCAFFERTY

From the curb, the house seemed to match its real-estate listing: "3 BR ranch, att dbl gar, patio." But when I hopped around back, that "patio" proved to be the typical bad joke of most developments. The only access to it was the garage's back door (top right photo, next page). Inside, the home's major drawback was a cramped, dark dining room. Before putting down earnest money, the prospective home buyer asked me to propose an addition that would make the home attractive for entertaining.

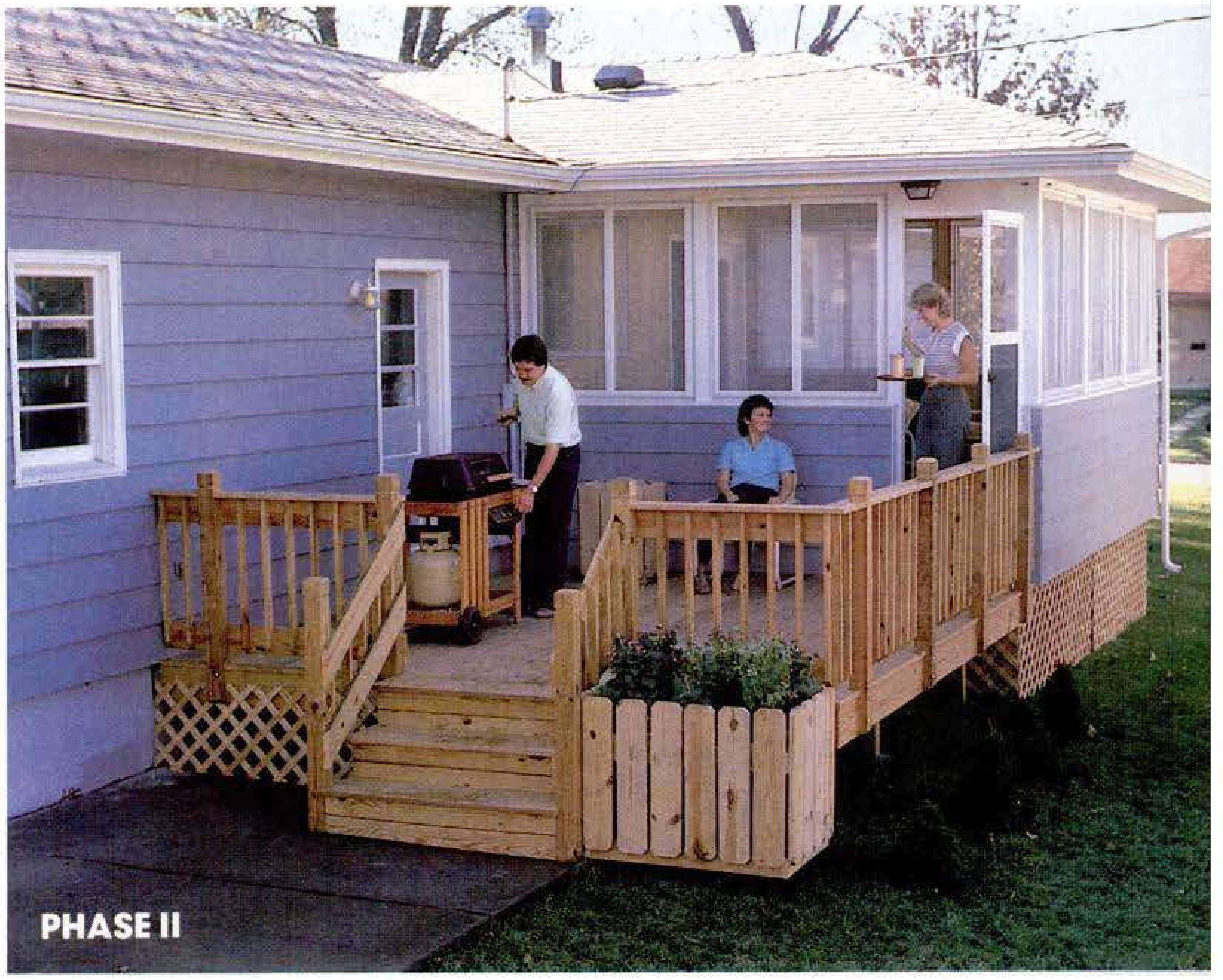
Tacking a room onto the kitchen/dining wall and adding an open deck would go far in that direction—but it would also block two foundation windows that brought light and air to the basement. The solution? Float the addition above them, leaving access through the crawl space beneath.

The other problem was financing, so we designed the addition to be completed in two stages, as shown in the table at lower left. This spreads costs over two summers while providing instant amenities with Phase I. By carefully framing the enclosed porch to take standard window sizes, you can wrap it in screening for this coming summer, then add the glazing next year, or whenever the budget allows.

If you match the siding and roofing to the existing house, the add-on will look like part of the original design. The open deck was easy to erect, thanks to Wickes Lumber's new 5/4 radius-edged, pressure-treated Deck Plank lumber, with precut components and plans. We also used the component railing system from Wickes.

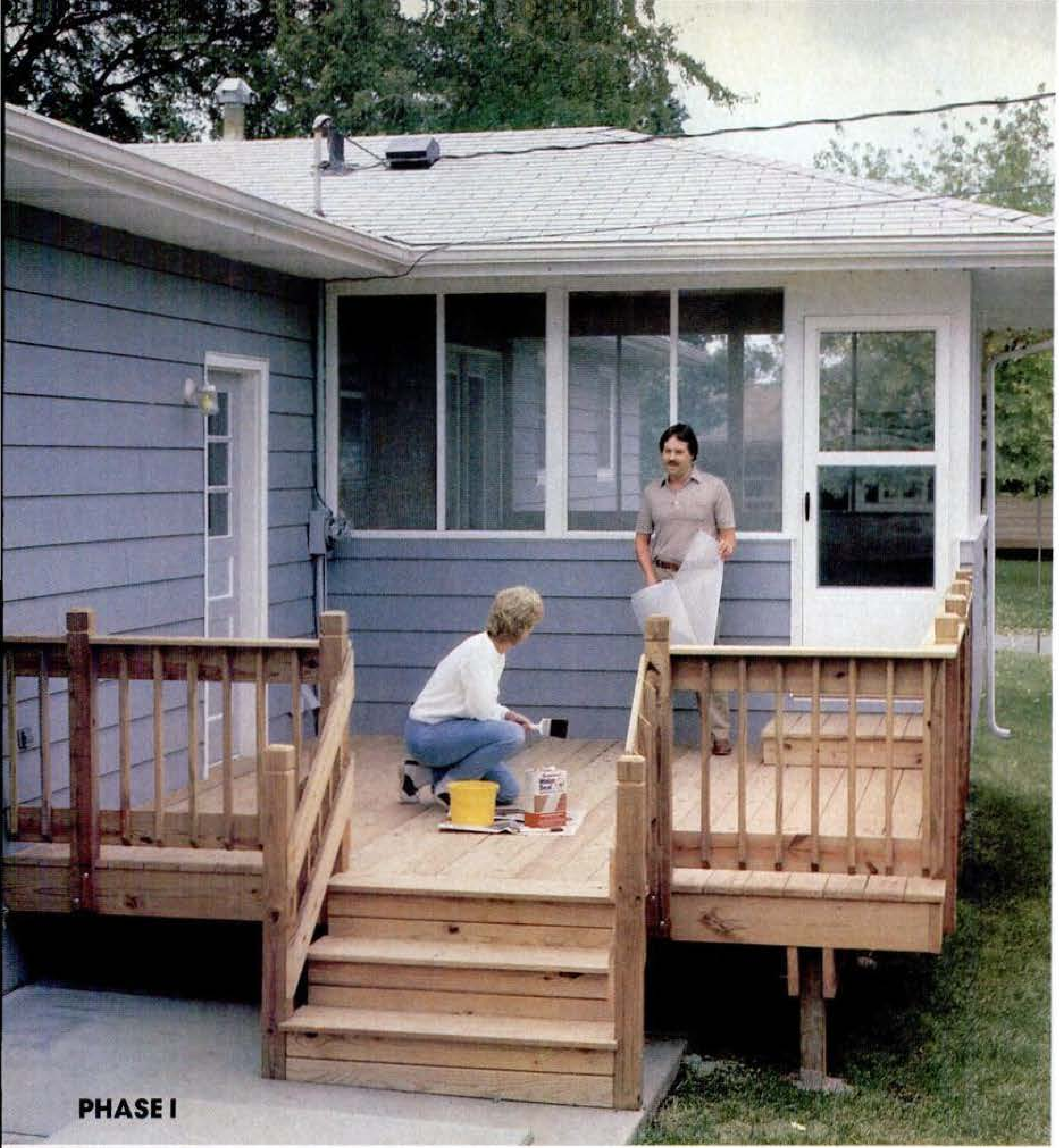
For this project's first summer, we built the enclosed porch and open deck, and replaced the existing slider

Continued

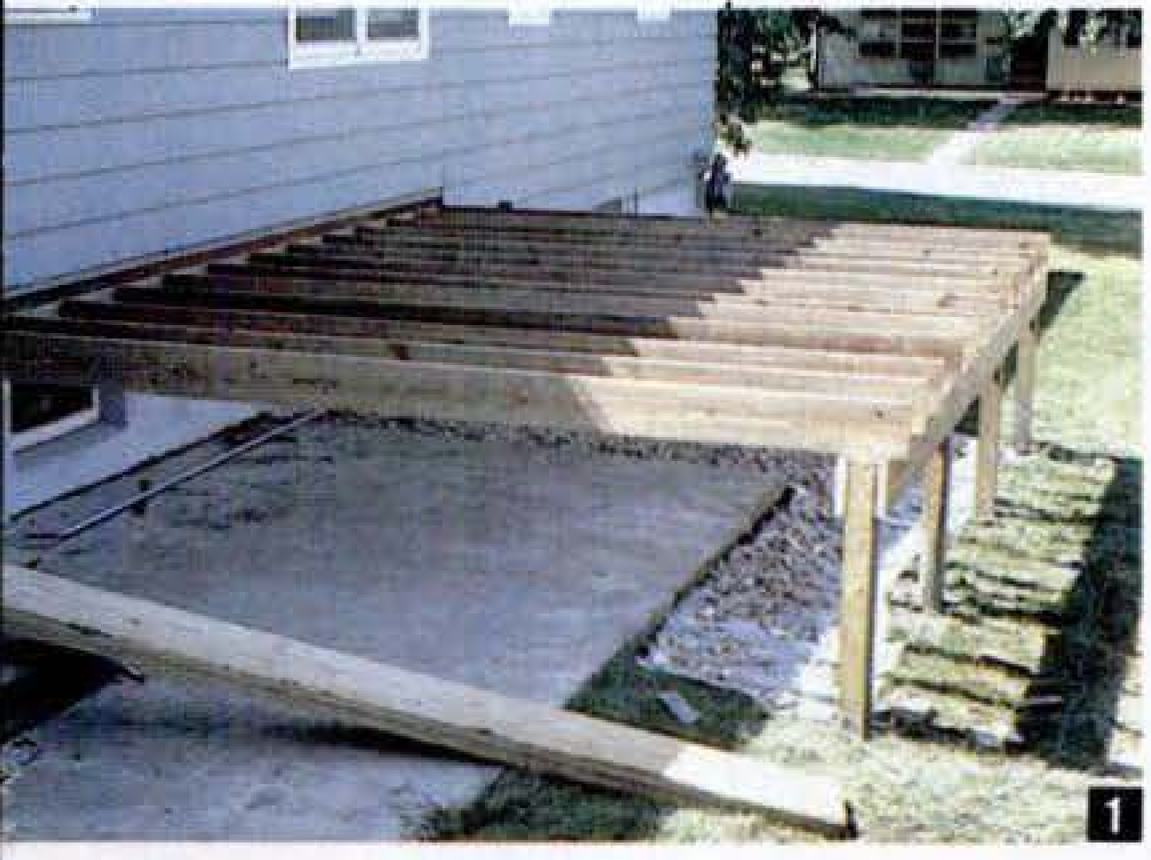


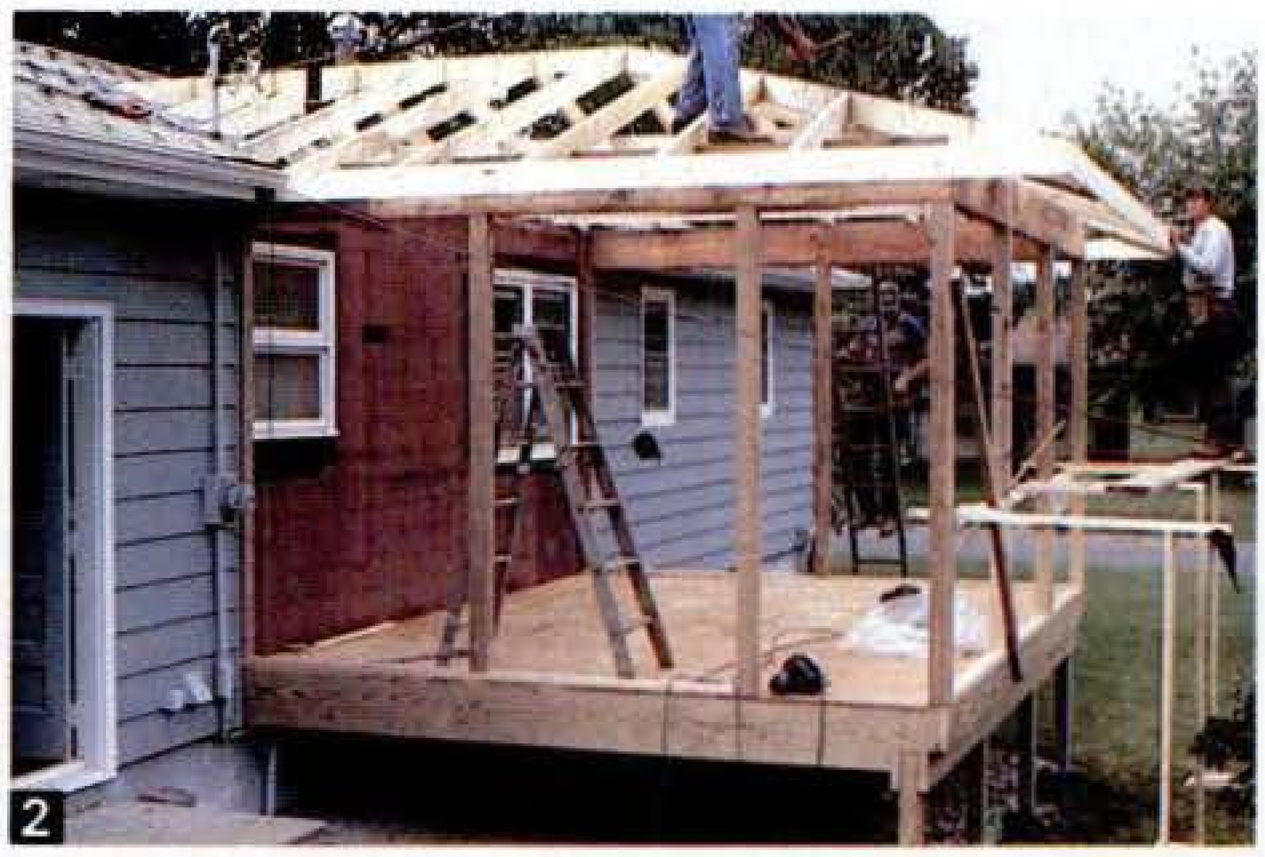
Two-phase cost spread

First Year:	Second Year:
Basic addition	Windows all around
Patio-door access	Pass-through casement
Deck	Finished ceiling
Screening	Paneling
Floor tile	Lattice skirting

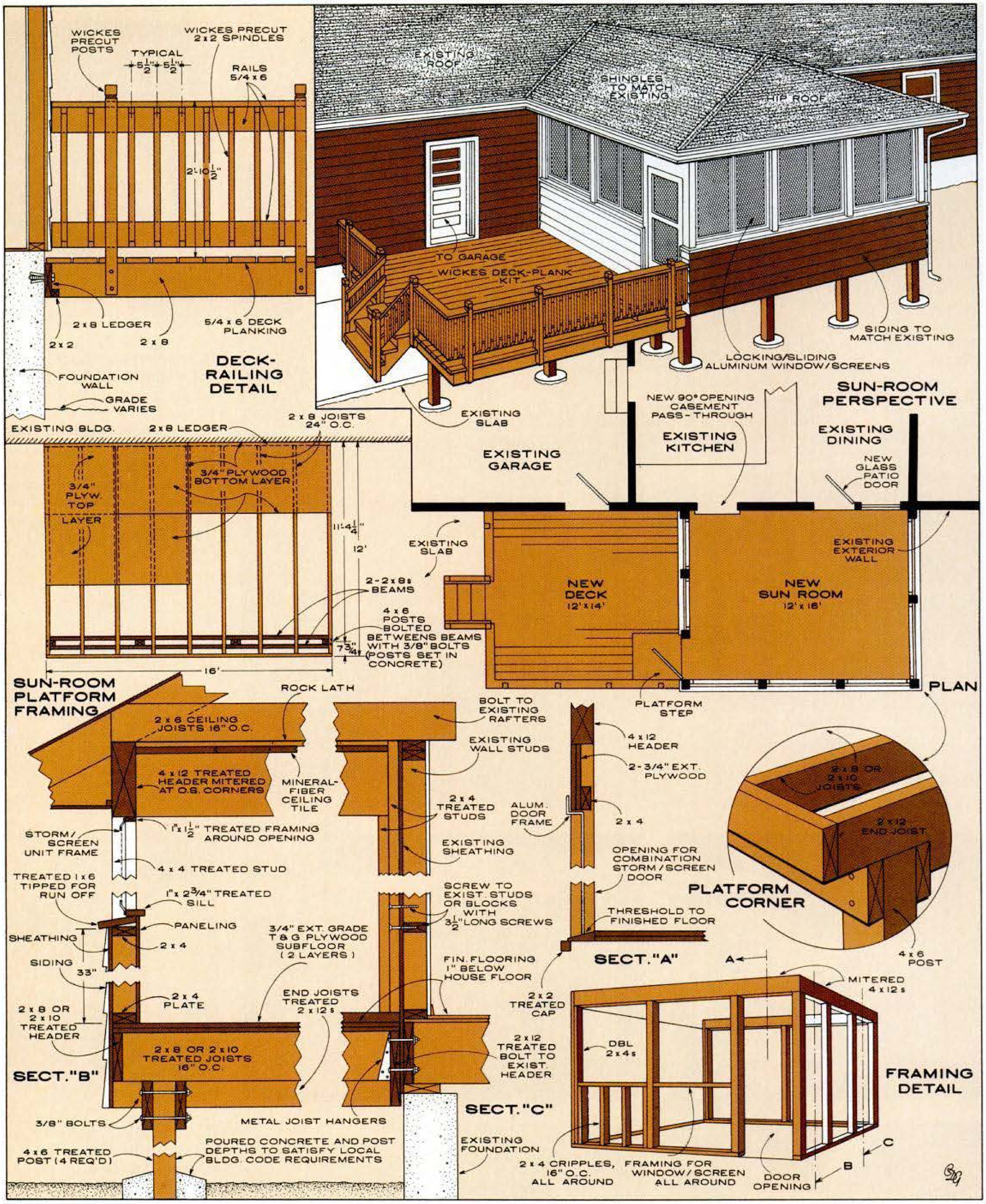


All-too-typical back stoop from the attached garage (above) meets a useless patio slab—this one even lacks access to kitchen and dining room (windows at right). First-phase addition, left, adds a screened porch and open deck. Last phase, on facing page, provides a sun room.





1 Floor joists span 2 × 12 bolted to the house and a beam supported by posts.
2 Posts and 4 × 12 headers on a plywood platform support the roof framing.
3 New room is now under shelter, so the window is replaced with a patio door.
4 Three support posts are added, and the open deck is framed; header is nailed across trimmed joists.
5 For Phase II, windows replace screening.


WICKES PRECUT POSTS
WICKES PRECUT 2 x 2 SPINDLES
TYPICAL 5½" 5½"
RAILS 5/4 x 6
2'-10½"
2 x 8 LEDGER
5/4 x 6 DECK PLANKING
2 x 2
2 x 8
DECK-RAILING DETAIL
FOUNDATION WALL
GRADE VARIES
EXISTING BLDG.
2 x 8 LEDGER
2 x 8 JOISTS 24" O.C.
EXISTING ROOF
SHINGLES TO MATCH EXISTING
HIP ROOF
TO GARAGE
WICKES DECK-PLANK KIT
SIDING TO MATCH EXISTING
LOCKING/SLIDING ALUMINUM WINDOW/SCREENS
EXISTING SLAB
SUN-ROOM PERSPECTIVE
NEW 90° OPENING CASEMENT PASS-THROUGH
EXISTING KITCHEN
EXISTING DINING
EXISTING GARAGE
NEW GLASS PATIO DOOR
3/4" PLYWOOD BOTTOM LAYER
3/4" PLYW. TOP LAYER
11'-4¼"
12'
EXISTING SLAB
2-2 x 8s BEAMS
4 x 6 POSTS BOLTED BETWEENS BEAMS WITH 3/8" BOLTS (POSTS SET IN CONCRETE)
7¾"
16'
EXISTING EXTERIOR WALL
NEW DECK 12' x 14'
NEW SUN ROOM 12' x 16'
PLATFORM STEP
PLAN
SUN-ROOM PLATFORM FRAMING
ROCK LATH
2 x 6 CEILING JOISTS 16" O.C.
4 x 12 TREATED HEADER MITERED AT O.S. CORNERS
MINERAL-FIBER CEILING TILE
STORM/SCREEN UNIT FRAME
1" x 1½" TREATED FRAMING AROUND OPENING
4 x 4 TREATED STUD
TREATED 1 x 6 TIPPED FOR RUN OFF
1" x 2¾" TREATED SILL
PANELING
SHEATHING
2 x 4
SIDING
33"
2 x 4 PLATE
2 x 8 OR 2 x 10 TREATED HEADER
2 x 8 OR 2 x 10 TREATED JOISTS 16" O.C.
SECT. "B"
3/8" BOLTS
4 x 6 TREATED POST (4 REQ'D)
BOLT TO EXISTING RAFTERS
EXISTING WALL STUDS
2 x 4 TREATED STUDS
EXISTING SHEATHING
SCREW TO EXIST. STUDS OR BLOCKS WITH 3½" LONG SCREWS
3/4" EXT. GRADE T & G PLYWOOD SUBFLOOR (2 LAYERS)
FIN. FLOORING 1" BELOW HOUSE FLOOR
END JOISTS TREATED 2 x 12s
2 x 2 TREATED CAP
2 x 12 TREATED BOLT TO EXIST. HEADER
METAL JOIST HANGERS
SECT. "C"
POURED CONCRETE AND POST DEPTHS TO SATISFY LOCAL BLDG. CODE REQUIREMENTS
EXISTING FOUNDATION
4 x 12 HEADER
2-3/4" EXT. PLYWOOD
ALUM. DOOR FRAME
2 x 4
OPENING FOR COMBINATION STORM/SCREEN DOOR
THRESHOLD TO FINISHED FLOOR
SECT. "A"
2 x 8 OR 2 x 10 JOISTS
2 x 12 END JOIST
PLATFORM CORNER
4 x 6 POST
A
MITERED 4 x 12s
DBL 2 x 4s
FRAMING DETAIL
C
B
2 x 4 CRIPPLES, 16" O.C. ALL AROUND
FRAMING FOR WINDOW/SCREEN ALL AROUND
DOOR OPENING

DRAWINGS BY CARL DE GROOTE

with Peachtree's hinged-panel patio door for direct access from the dining room. We covered the porch floor with a frost-free ceramic tile.

The following year, the first step was to replace the screening with storm-screen window units. We then added light-colored paneling and ceiling tile and replaced the double-hung kitchen window with a casement that becomes a pass-through for serving refreshments. Since this porch is still the only source of daylight for both kitchen and dining room, we kept its furnishings bright. We might even add a skylight later. If your new sun porch happens to face south, you'll benefit from solar gain as a bonus. PS

PARTICIPATING MANUFACTURERS

The following products were chosen by PS for this project: **Armstrong World Industries,** Box 3001, Lancaster PA 17604 (fissured ceiling tile); **Charmglow Products,** Box 310, Bristol WI 53104-0310 (barbecue grill); **Color Tile,** Box 2475, Fort Worth TX 76113 (frost-proof ceramic tile); **Masonite Corp.,** Box 311, Towanda PA 18848 (Royalcote Woodfield chestnut paneling); **Peachtree Doors,** Box 5700, Norcross GA 30091 (Prado hinged patio door, casement window); **Samsonite Furniture,** Box 189, Murfreesboro TN 37130 (Body Glove in Buttercream 'n Blue fabric); **Wickes Lumber,** Box 2030, Vernon Hills IL 60061 (Deck Plank)

IMPROVE YOUR HOME

Build a tuck-anywhere laundry room

You can create a laundry room in a nook or closet, or reclaim space in the utility room, with stacking washers and dryers. Some newer models handle full-size loads.

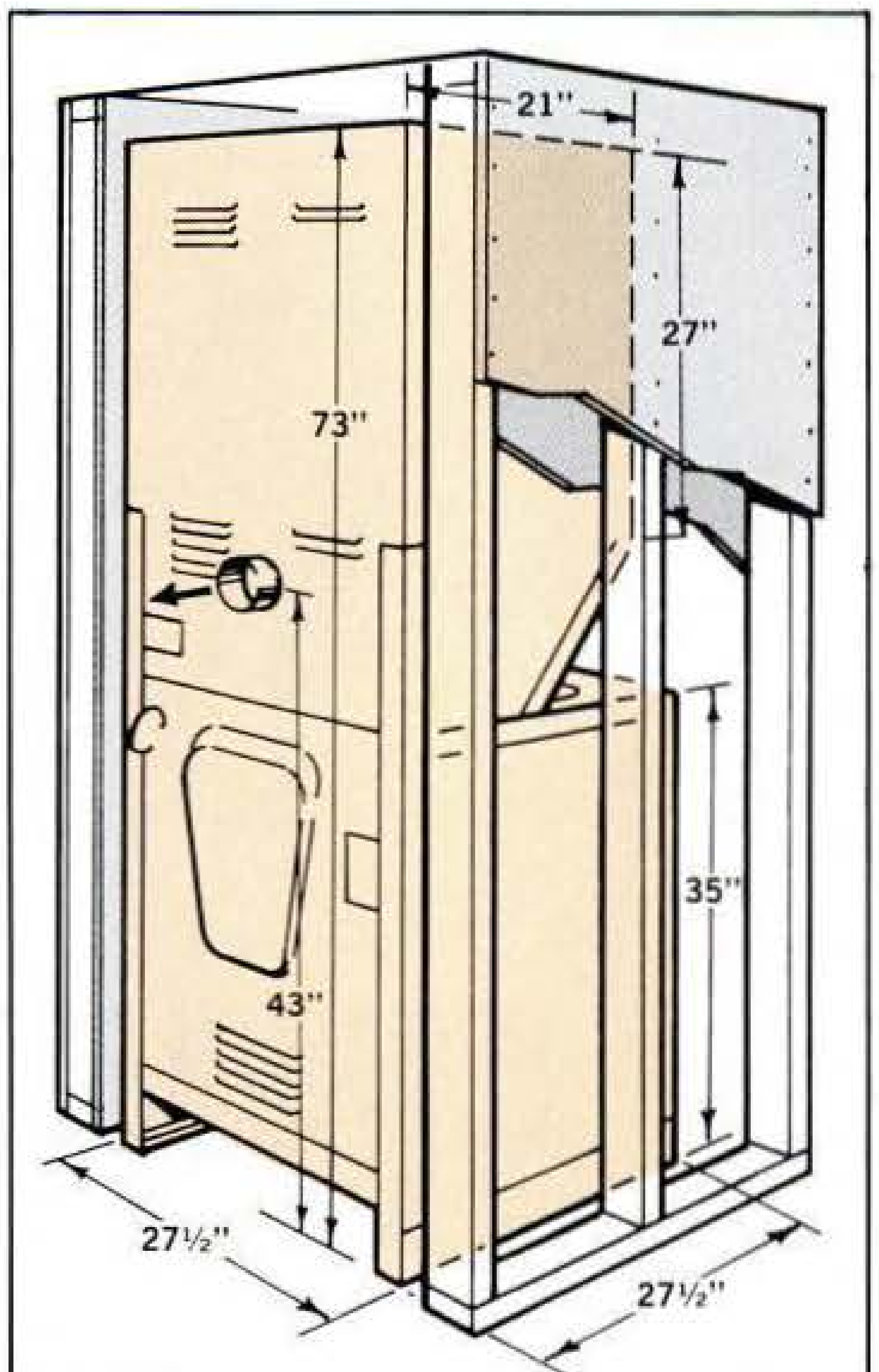
By V. ELAINE GILMORE

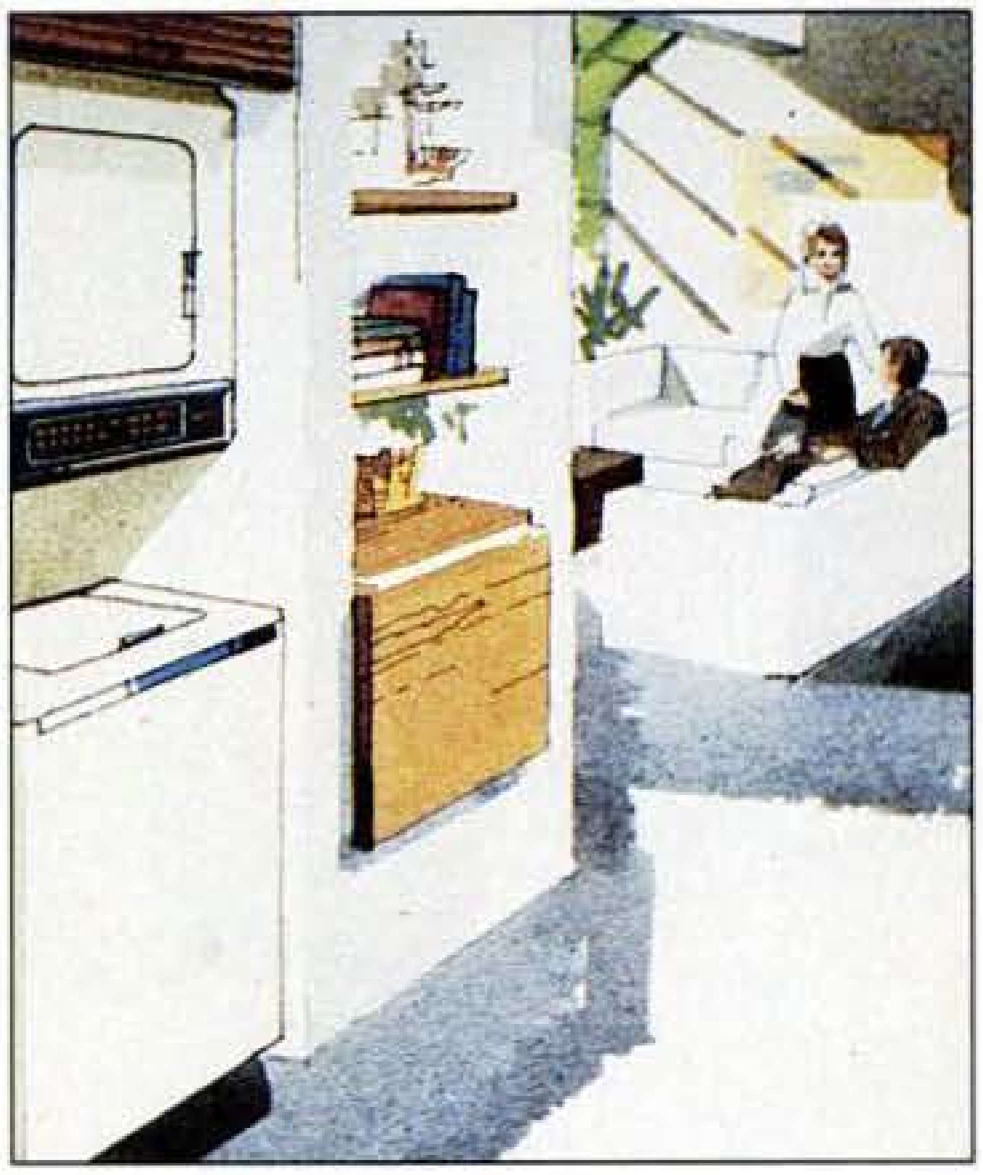
Where would you like to have your laundry room? In the bathroom? In a hall near the bedrooms? In the kitchen? Such convenience has become easier now that manufacturers are introducing cleverly designed top-loading washers and dryers that handle large loads and stack without a rack. Your only limitations: access to utility and plumbing lines, and an outside wall through which to vent the dryer.

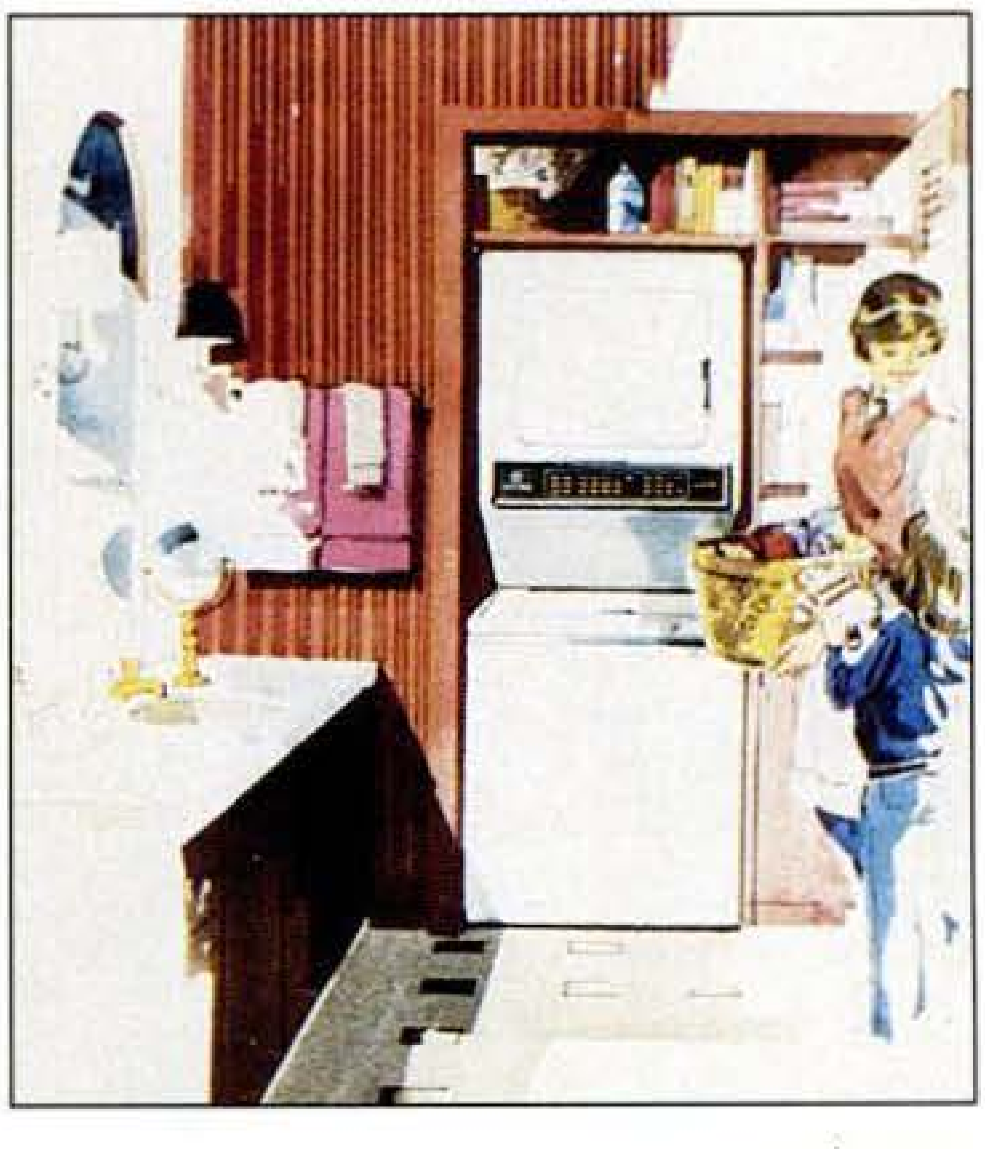
Building-in these stacking machines requires only simple framing topped with wallboard or plywood, as you can see in the sketch. The full-size Maytag pair shown needs a 27½-inch-square floor space. (Note how the base of the dryer is angled to give access to the top-loading washer.) Speed-Queen also has a full-size stacked set, and many companies offer compact stackers with front-loading washers.

If you build-in a washer and dryer, you may want to add storage space or provide for other activites. For example, what had been a utility room was transformed, as the top photo shows, with the addition of an exercise and entertainment area. PS

While clothes wash, you can exercise, listen to music, or watch TV in this handsome multipurpose room (above). Stacking machines freed floor space.

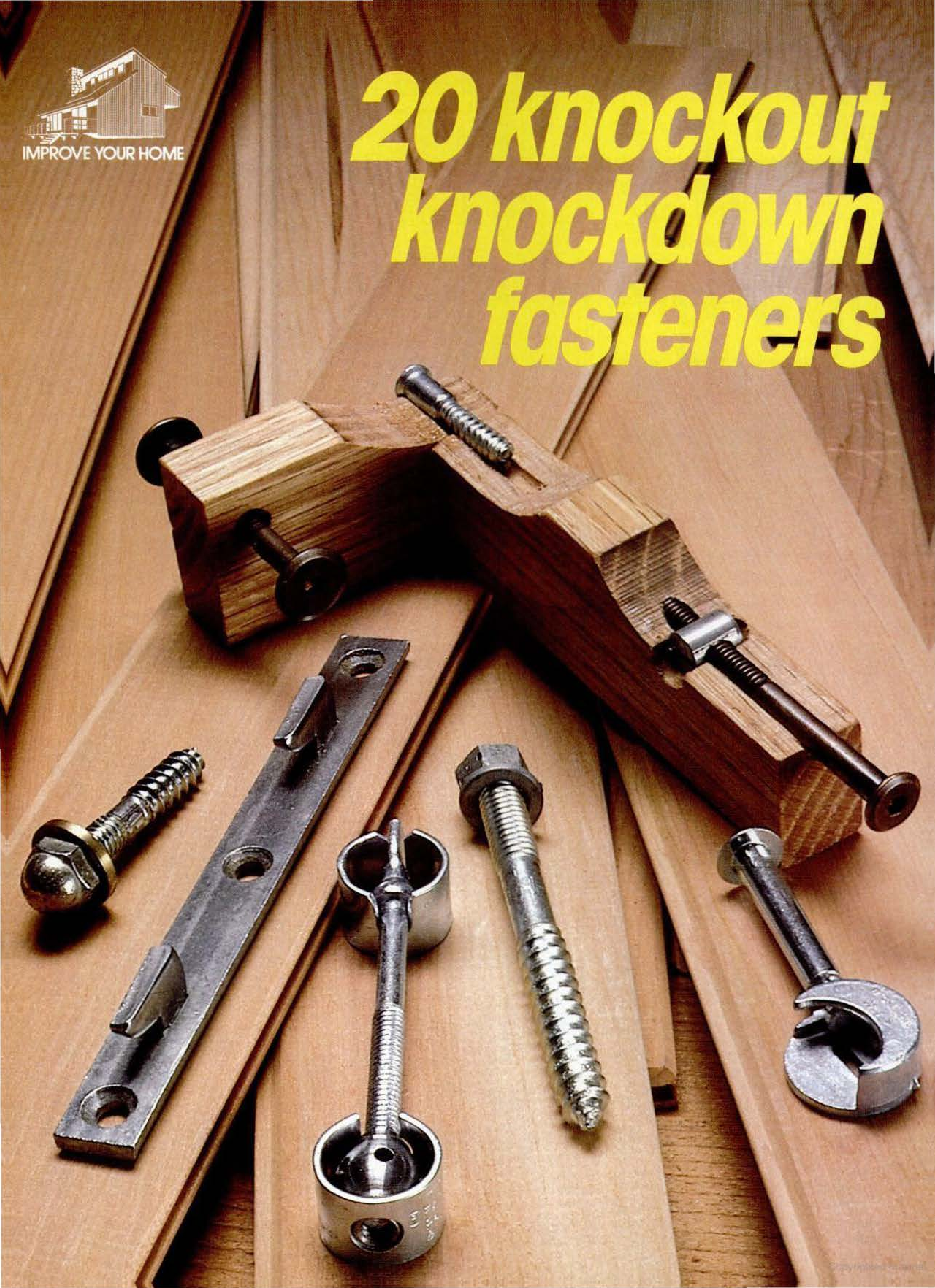






Washer-dryer can be put in a closet (above right). When machines are not in use, an elegant tambour door closes to conceal them. Bathroom (right) is a convenient place for a laundry. Dimensioned sketch shows how to build-in Maytag pair; their price is comparable with Maytag's other top-line machines.

20 knockout knockdown fasteners



Knockdown fasteners form sturdy joints that can be assembled and taken apart easily—without wear and tear. You can use these clever fasteners to build tables, bed frames, shelves, and cabinets. For some jobs they may even be better than conventional fasteners.

By PHIL McCAFFERTY
Photos by Greg Sharko

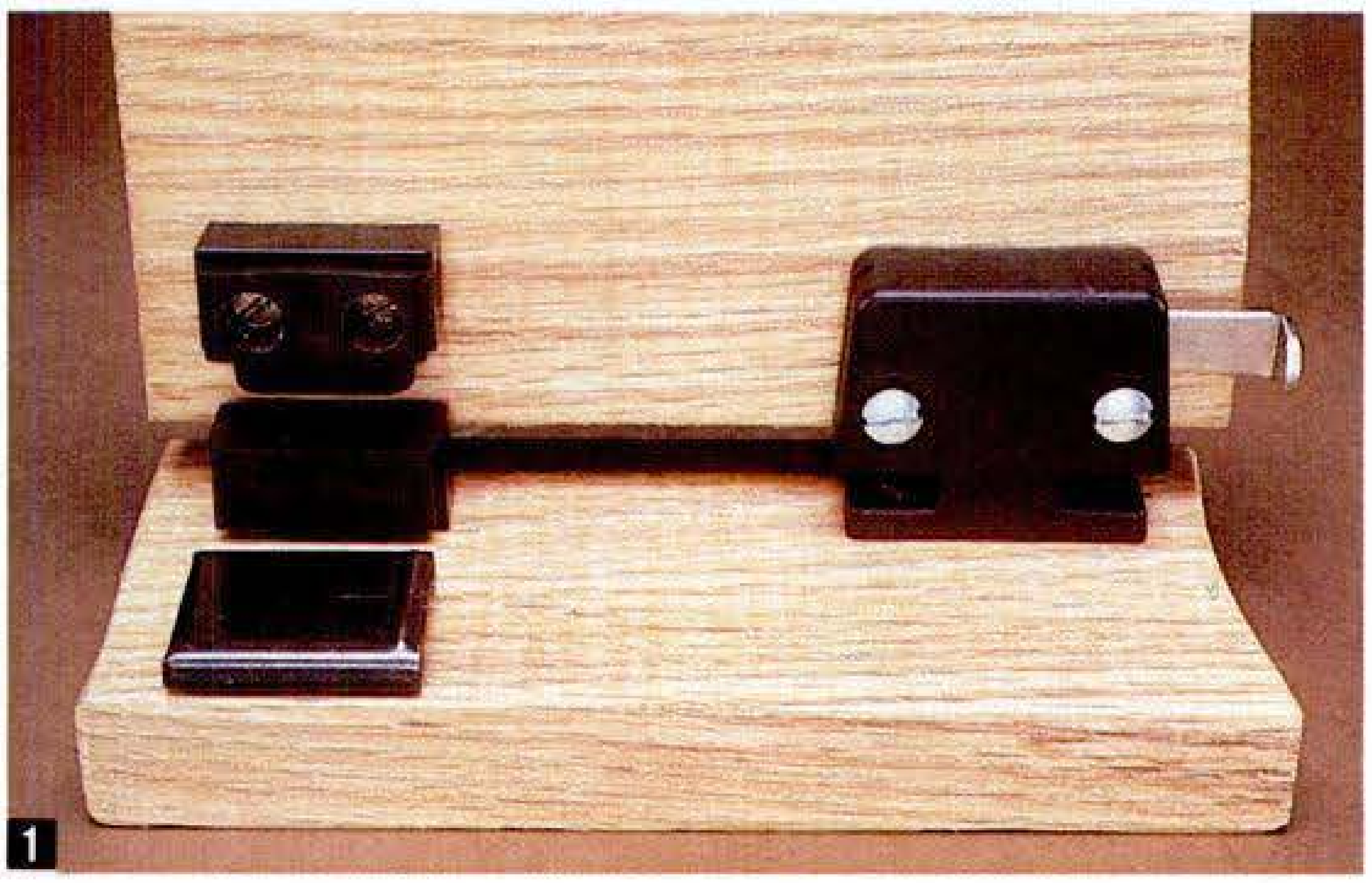
No, it's not time to throw away your dowels, nails, nuts and bolts, or screws—yet. But if you're planning to build projects that are easy to take apart, store in a tight spot, and reassemble, then a variety of knockdown fasteners will come in handy.

These clever devices offer a fast, sturdy method of forming secure joints that fit together and come apart in ingenious ways—without wearing out the hardware or the holes. But that isn't the fasteners' only asset.

Building with knockdown devices may be faster than using screws and glue for some projects. Knockdown furniture is typically built with easy-to-make butt or overlapping joints rather than complicated and time-consuming mitered and dadoed joints. That also makes figuring part dimensions easier because you don't have to consider the depth of complicated joints. Also, you can sand and finish the parts before assembly: It's easier and faster to sand a flat board than one with joints cut in.

Second, with a knockdown joint the wood is free to swell or contract without being damaged. In conventional fur-

Continued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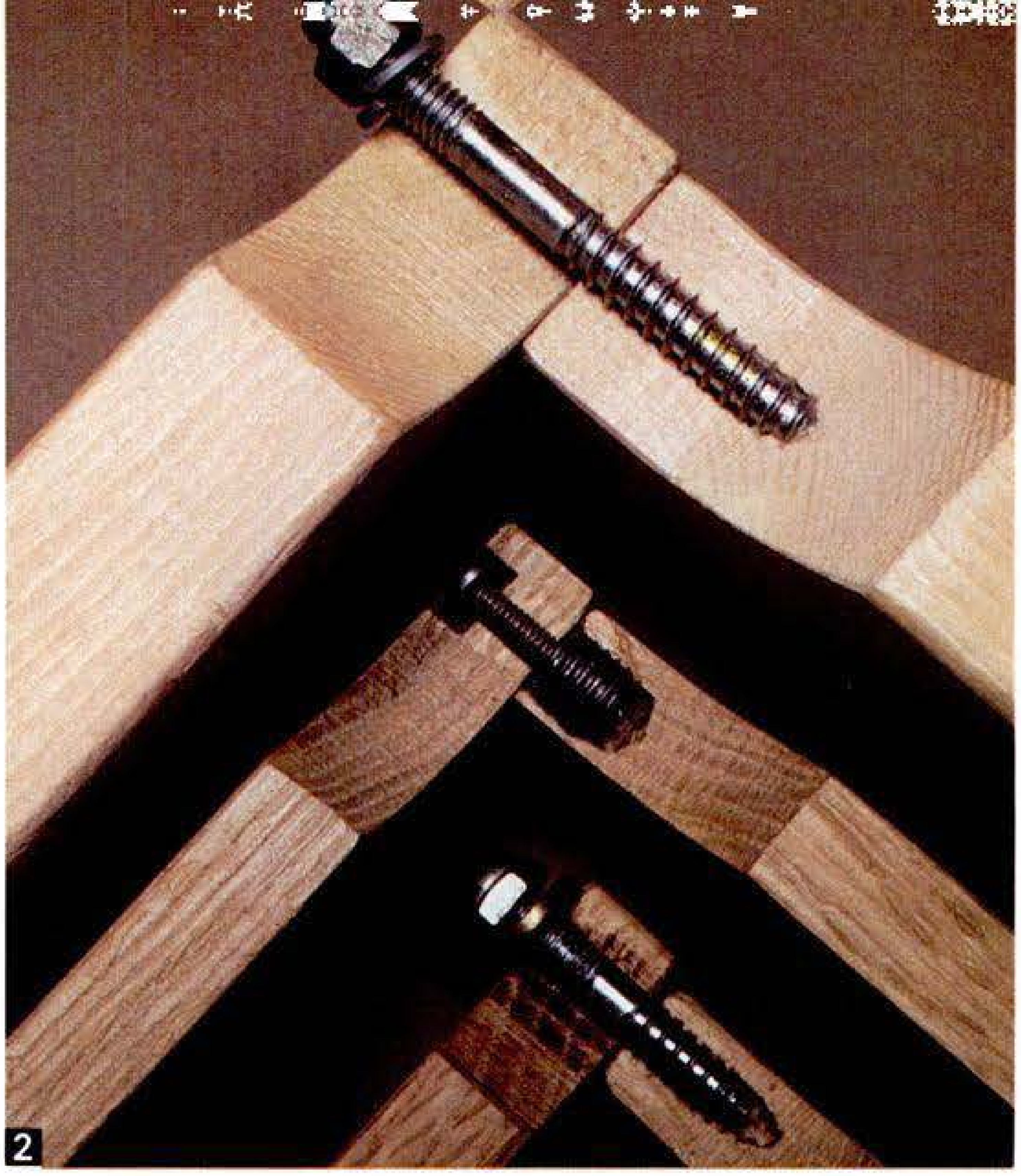
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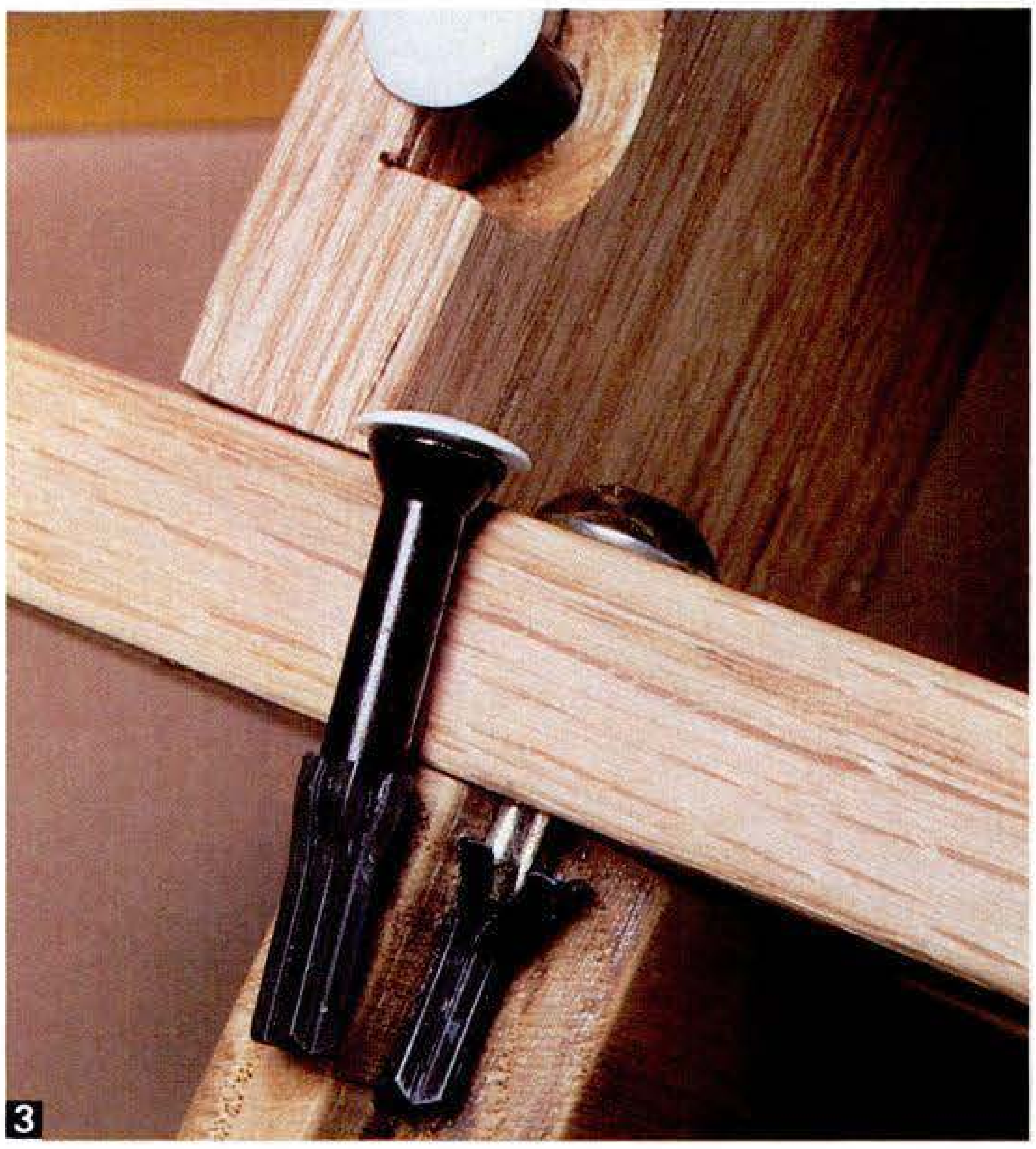
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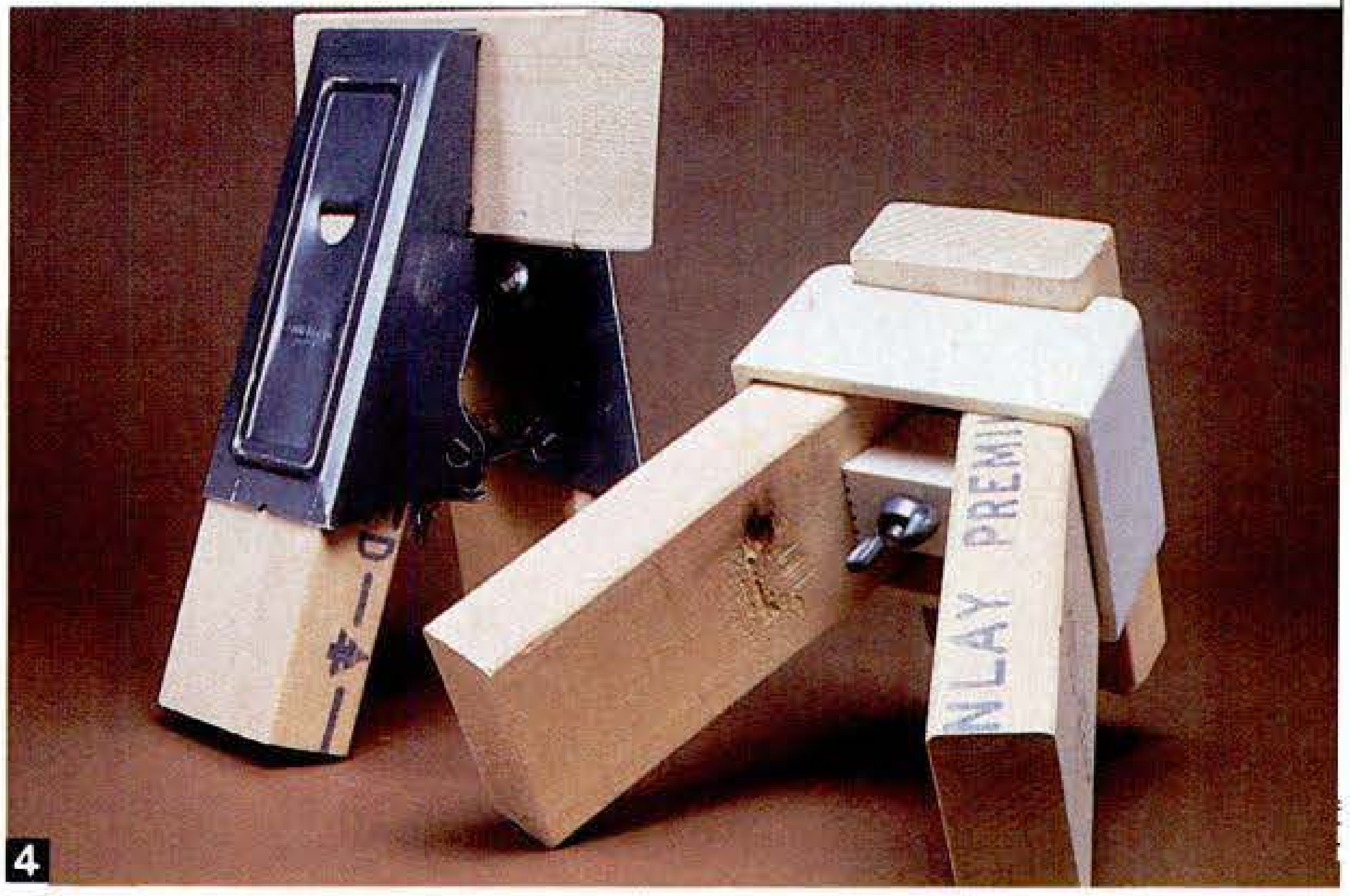
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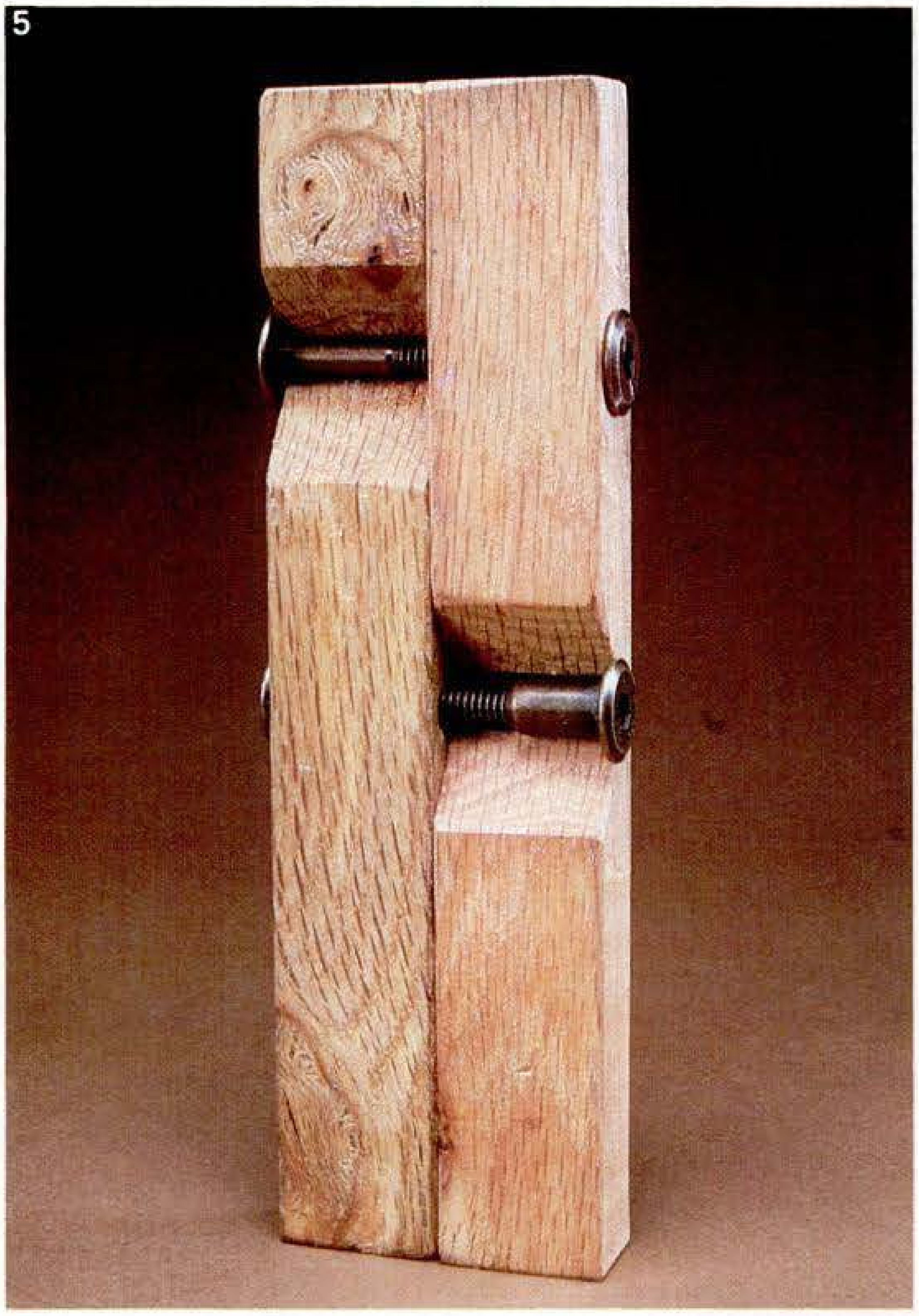
1 Here are two shortcuts in assembling cabinets. To secure the plastic connector from Constantine (right), push the two slotted mating pieces together, then insert a steel wedge bar into the slot. Remove the bar, and the joint comes apart. In a like device (left) from The Woodworkers' Store, a metal locking clip slides over plastic blocks to hold them fast.
2 Hanger bolts (top) from Constantine can be dressed up with crown-head nuts (bottom) for indoor furniture. The threaded nut (middle) takes a machine screw and is mounted 1/16 to 1/8 in. below the surface. To hide the screw head, use a cover plug. The nut is available from Armor, Craftsman, DRI, Trend-Lines, Woodcraft, and The Woodworkers' Store.
3 To install Jawbolt (from Jaw Mfg.), drill the mating pieces and tap in the assembled bolt. A few turns with an allen wrench flares out the anchor.
4 Knockdown sawhorses cut workshop clutter. A 2-in.-high plastic model from Sears, Trend-Lines, and Woodcraft holds a 2×4 flat. The two-piece sawhorse is bolted together; to disassemble, unscrew the wing nut. A stamped-steel version from Constantine holds a 2×4 on edge.

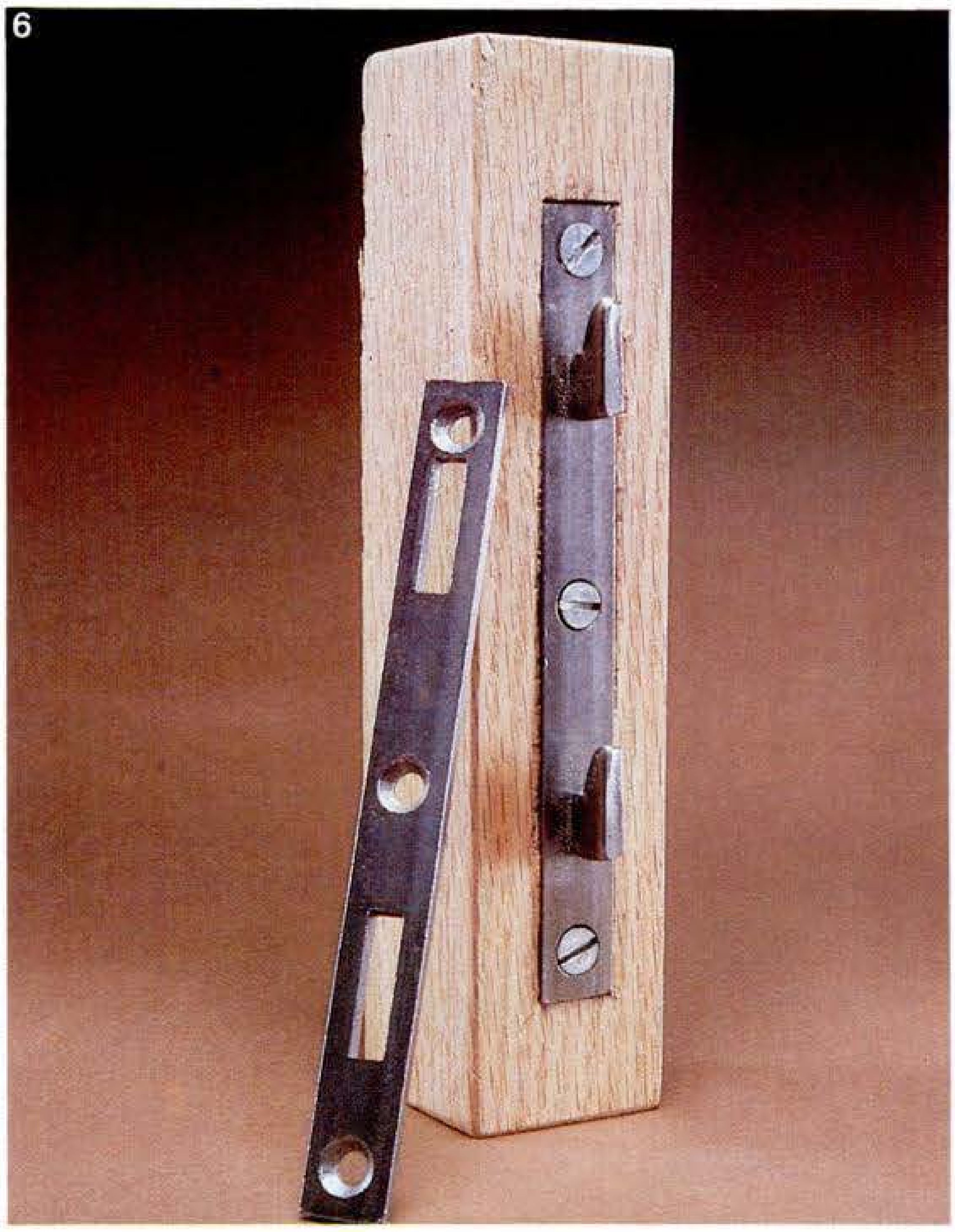


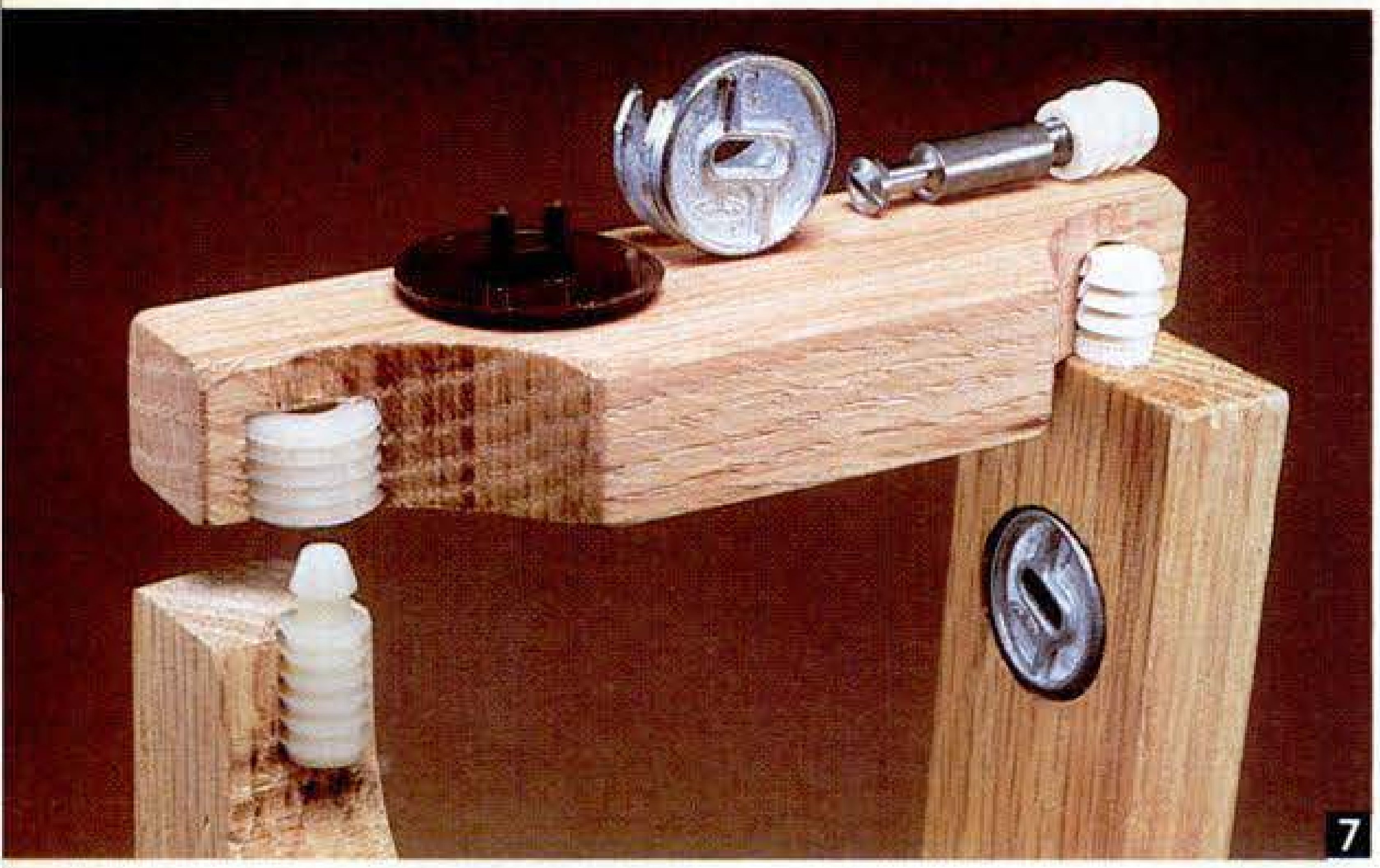
niture, a joint locked up with glue can't give and can crack from excessive swings in temperature and humidity.

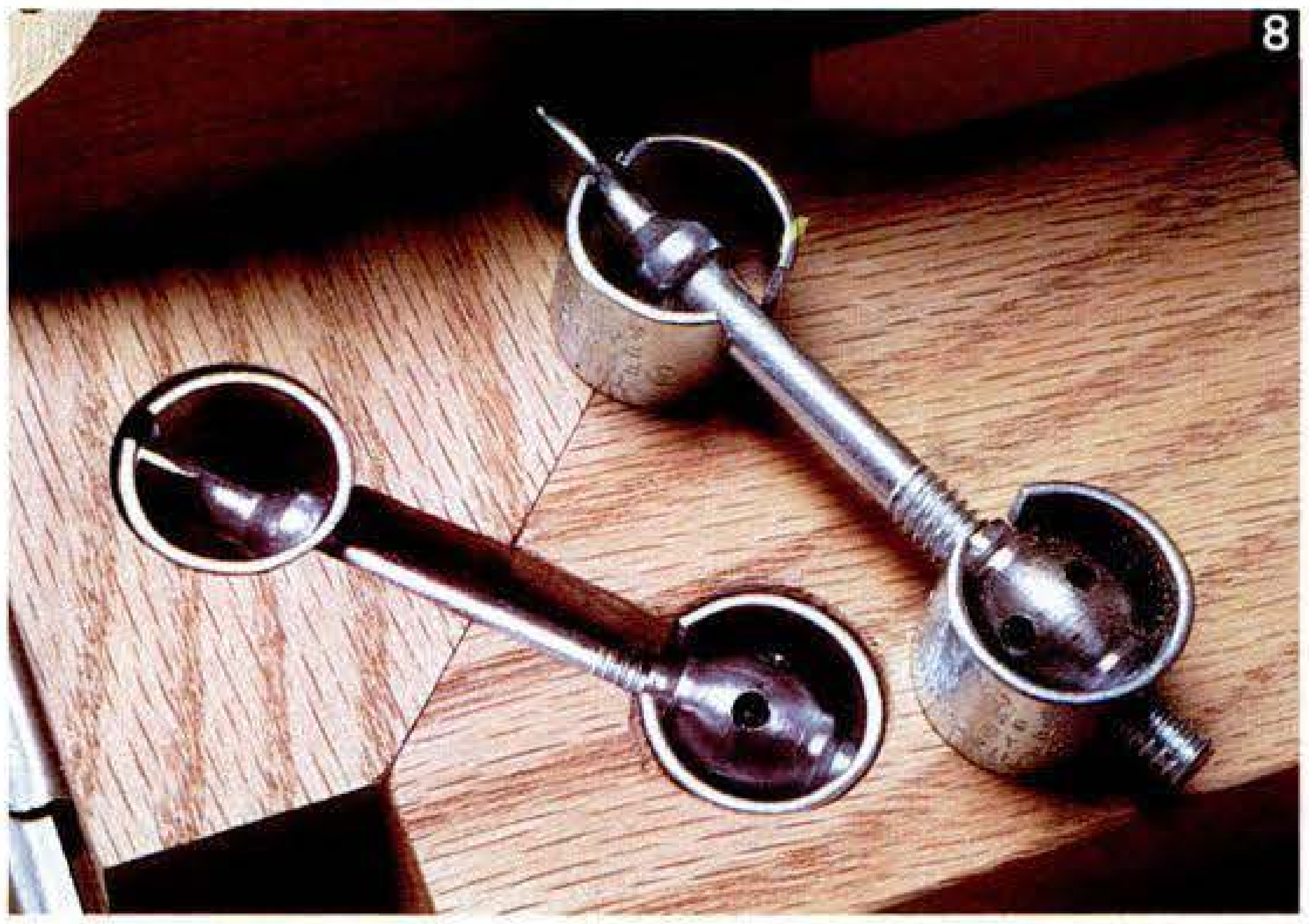
You don't have to sacrifice looks to use knockdown fasteners, either. You can hide some fasteners in blind holes. Others, such as the joint connectors shown in photo 1, fit inside the project. Often those that can be seen are unobtrusive, or can be hidden with decorative caps. You are, however, limited in your design options. A basic rule: Simple is better. I recommend using knockdown fasteners for straightforward projects like chairs with flat sides, shelves, bed and sofa frames, rectangular cabinets, flush cabinet doors, simple legs, and flat panels.

Keep in mind that not every joint in a knockdown piece must use a knockdown device. For example, narrow stock can be glued up into panels for drawers that won't be taken apart, even though they'll be in a knockdown cabinet.

There are a few dos and don'ts for knockdown hard-







5 Connector bolts with cap nuts from The Woodworkers' Store are ideal for connecting the sides of adjoining cabinets and for fastening cabinet sides to interior vertical supports. The flathead bolts come in two lengths for connections from $1\frac{3}{16}$ to $2\frac{1}{4}$ in. thick.

6 To install this rugged bed-rail fastener from The Woodworkers' Store, inlay one piece on the bed rail, the other on the bed post. For bed frames, there are also knockdown surface-mount corner fasteners from Armor, Craftsman, and Woodworker's Supply. Bed-rail fasteners can also be used on chair and sofa frames.

7 For hidden hardware, use the invisible plug and socket connectors from The Woodworkers' Store—they fit into blind holes. To connect them, push the joints together. In the Elite fitting from The Woodworkers' Store, the shaft is threaded into a blind socket that's pushed into a hole. The other end fits into a cammed disc that turns to lock.

8 Tite Joint fasteners from Craftsman and The Woodworkers' Store apply even pressure for assembly of counter tops, wood panels, and furniture. To tighten or loosen the fasteners, insert a small supplied rod in the ball nut and turn. There's also a special drill bit and drill guide.

ware. You must be exact when lining up the mating components of a fastener. There are several ways to accomplish this. For bolt-type fasteners (see photos 2 and 5), align and clamp the wood pieces together, then drill through both parts. If the hole in one piece needs to be enlarged to accept the hardware, as it does for threaded nuts (see photo 2), unclamp the pieces and redrill. If you're sinking blind holes, drill one member first. Then use dowel centers to transfer the layout to the mating part. If you're working with hanging devices like shelf brackets (see photo 11), fasten one of the mating components to the wood. Then hold it to the mating surface and carefully mark the location of the hardware's side and end. Finally, drill the holes and fasten the remaining hardware piece.

The don'ts are simple but crucial. Don't be stingy with the number of devices you use. On a wide-railed, heavy water-bed frame, for example, use two bed-rail fasteners on each corner. And don't skimp on the screws that fasten the devices in place. Use the longest screws appropriate, and be sure they are driven into sound material. Finally, don't subject the piece to excessive loads. Knockdown fasteners may not be as strong as conventional fasteners, so it's good practice to protect them from stress when possible. If a cabinet top will carry a load, for example, make the top overlap and rest on the sides rather than have the sides overlap the top. Another option is to use cleats and aligning blocks for support. PS

SOME SOURCES OF KNOCKDOWN FASTENERS

Armor Products, Box 445, East Northport NY 11731; **Constantine,** 2050 Eastchester Rd., Bronx NY 10461; **Craftsman Wood Service Co.,** 1735 W. Cortland Ct., Addison IL 60101; **DRI Industries,** 11100 Hampshire Ave. S., Bloomington MN 55438; **Sears, Roebuck and Co.,** Sears Tower, Chicago IL 60684; **Theatrical Warehouse,** 1108 Quaker St., Dallas TX 75207; **Trend-Lines,** 375 Beacham St., Chelsea MA 02150; **Woodcraft Supply Corp.,** Box 4000, Woburn MA 01888; **The Woodworkers' Store,** 21801 Industrial Blvd., Rogers MN 55374; **Woodworker's Supply of New Mexico,** 5604 Alameda N.E., Albuquerque NM 87113

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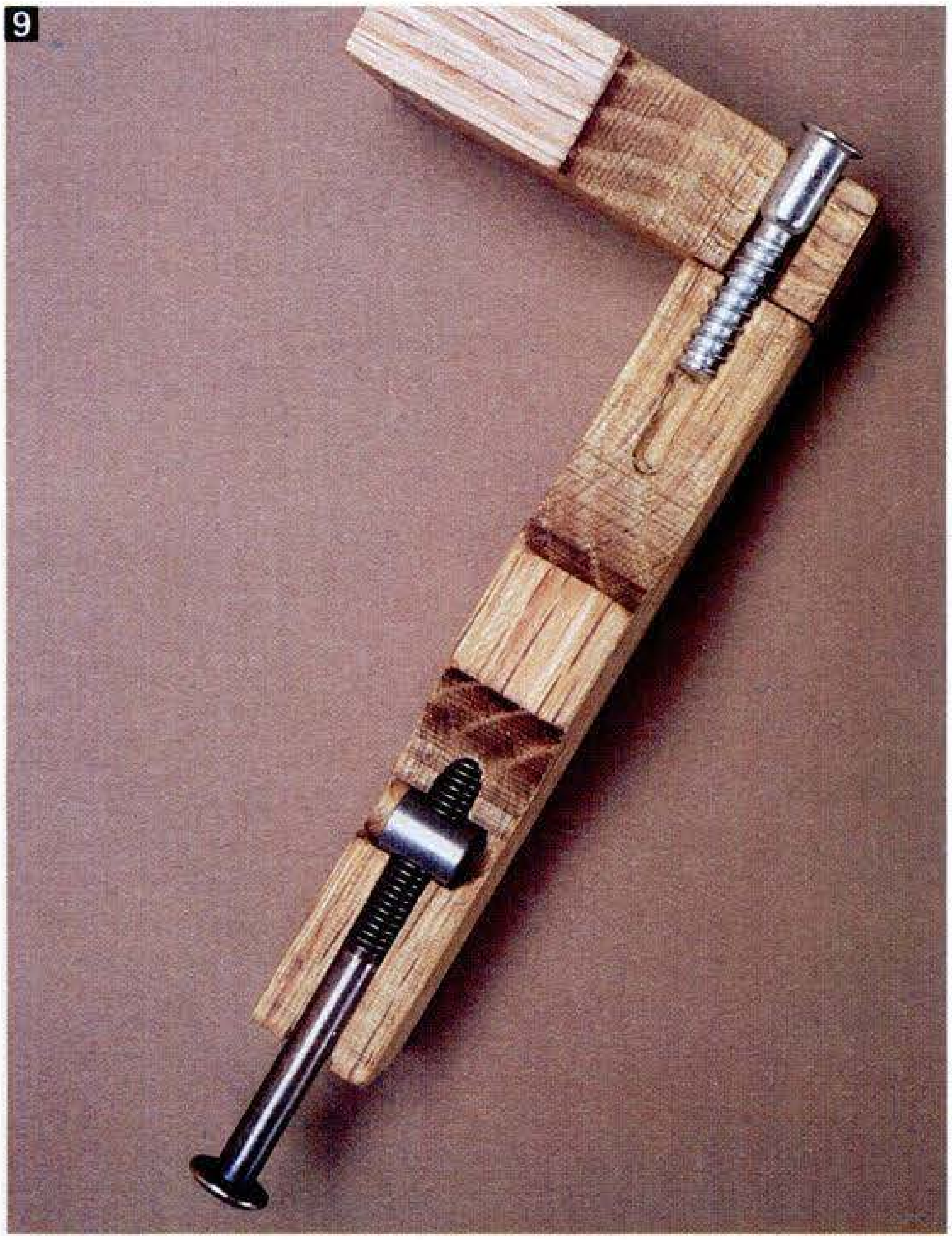

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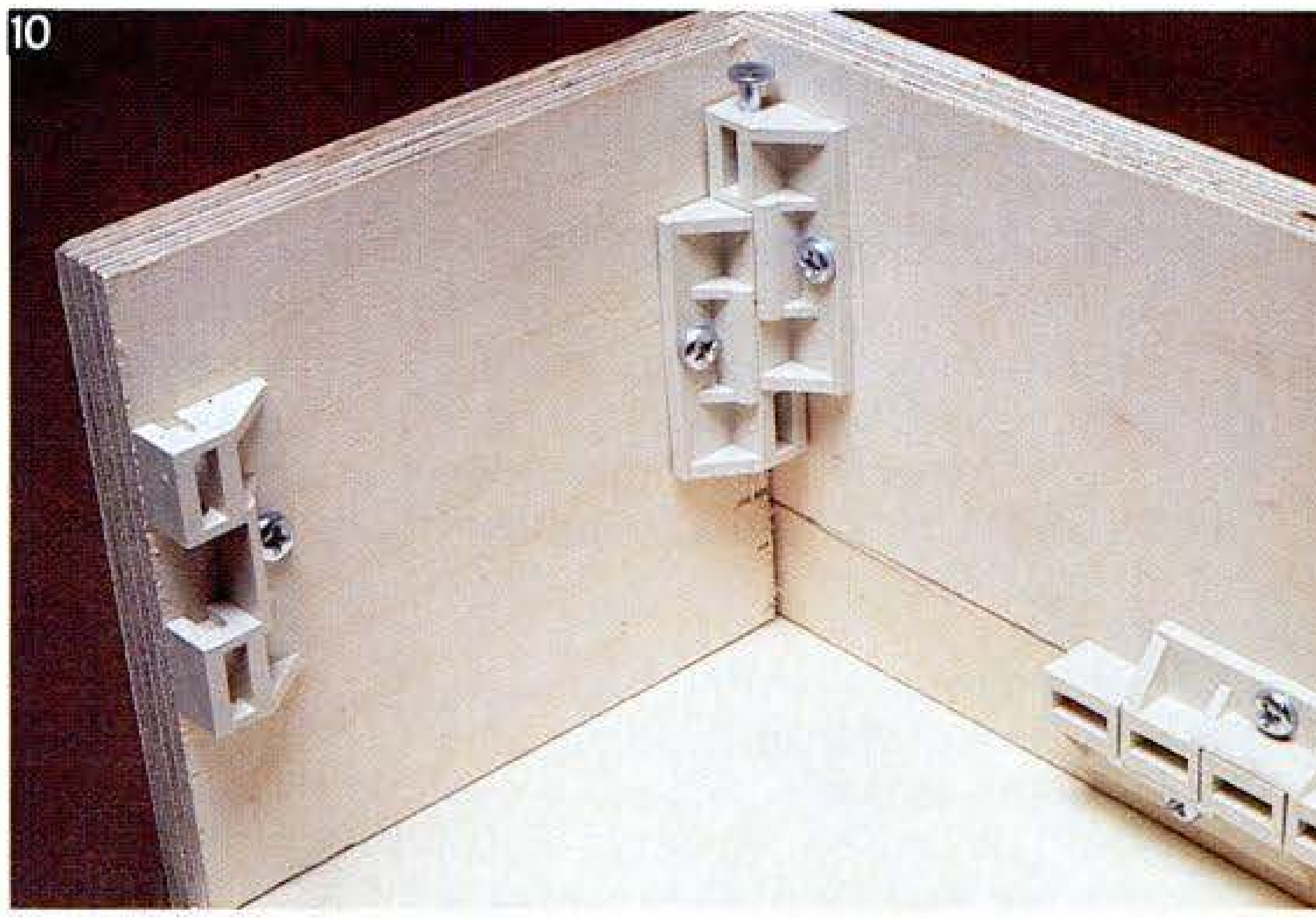

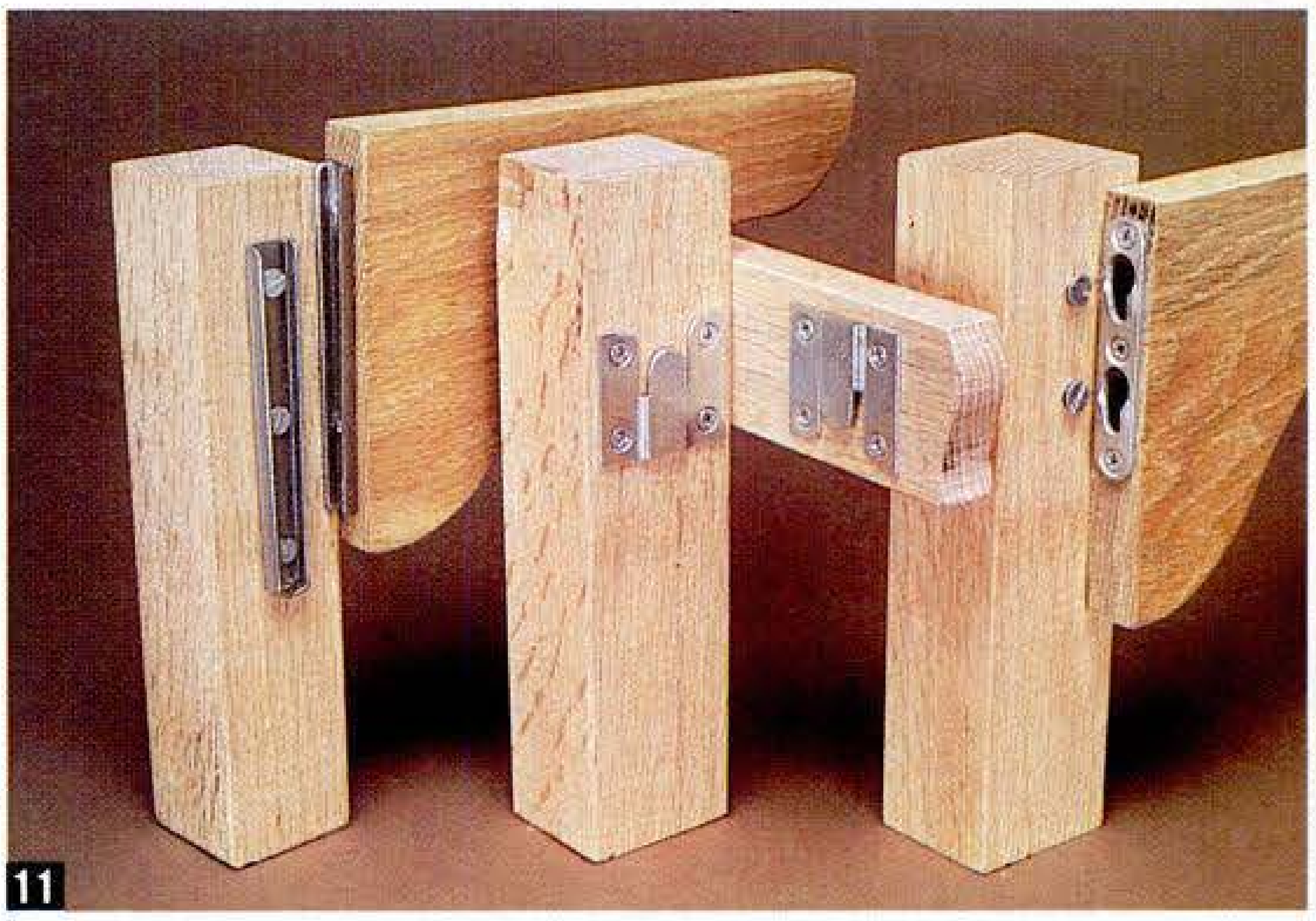

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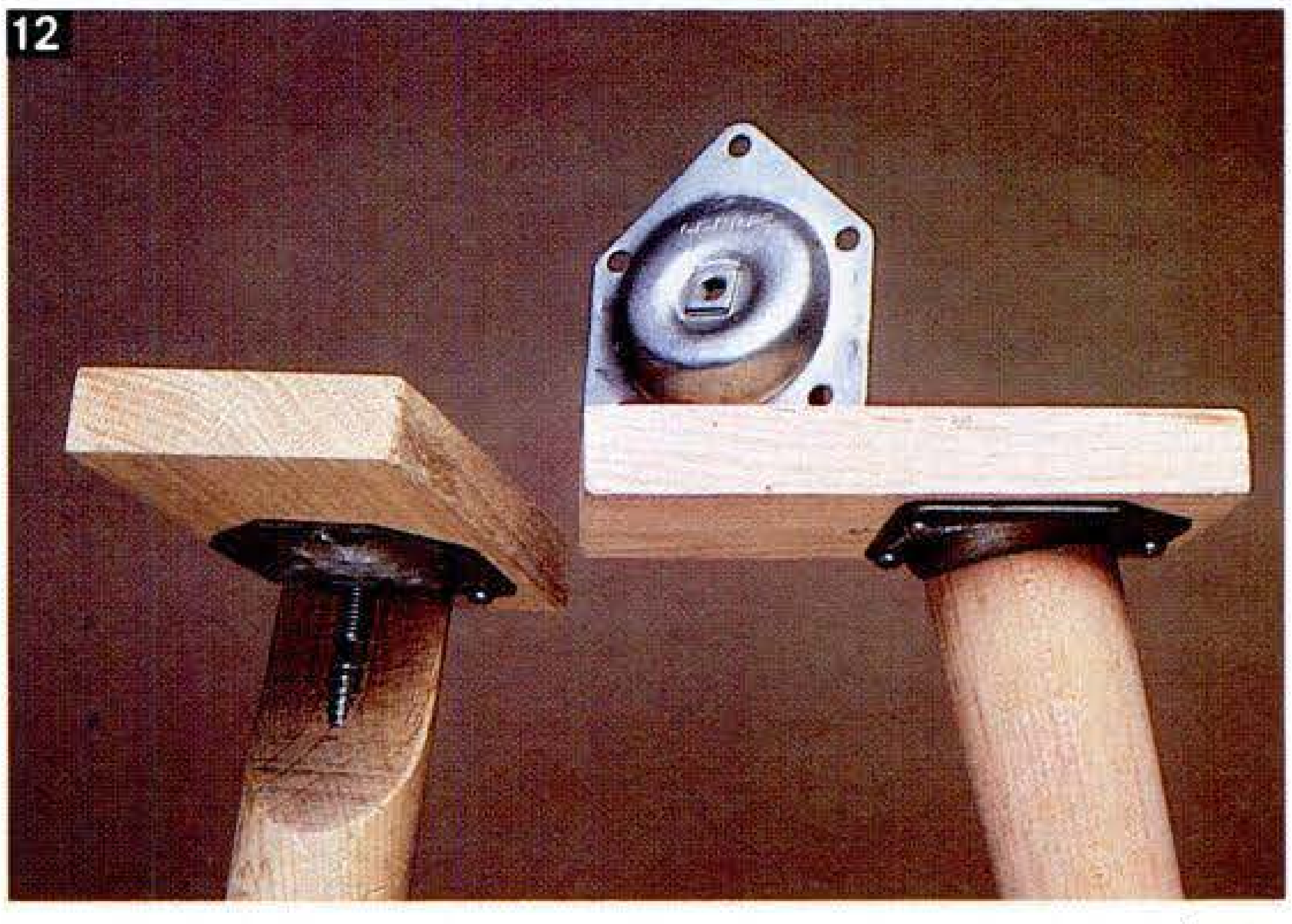


9 Lag screw (top) is available in 1½- and 2-in. lengths. The flat head can accept a decorative brown cap. To install the cross-dowel bolts (bottom), use a screwdriver to turn the slotted threaded dowel so it can accept the bolt. Both fasteners are from The Woodworkers' Store.

10 Knockdown fasteners are a boon to the theater, where bulky scenery is used repeatedly and storage space is tight. One stage-struck device is the Brooks Fastener System, from Theatrical Warehouse. To install it, drill four holes for the two identical plastic pieces. Secure them and slide the pin in, and you've formed a tough right-angle joint.

11 Here are three ways to hang wall units, cabinets, or shelving with knockdown fasteners from Constantine and The Woodworkers' Store. The taper connector (left) comes in 4- to 6-in. lengths. The two parts of the hanger (center) interlock with the help of a slightly raised tongue. The fastener is only ⅛ in. thick when mounted. The hardware at right uses protruding screws to hook into a mating surface.

12 For knockdown furniture legs, use nut plates available from Craftsman and The Woodworkers' Store. Ready-to-use commercial legs have mating fasteners installed. If you make your own legs, use 5/16-in. hanger bolts for fasteners.

IMPROVE YOUR HOME

Play patio parquet with drop-in-place deck squares

Cracked slab? No patio at all? The cure is easy: Cover the area with pre-built Deck Squares. You just drop the squares into position and nail them in place.

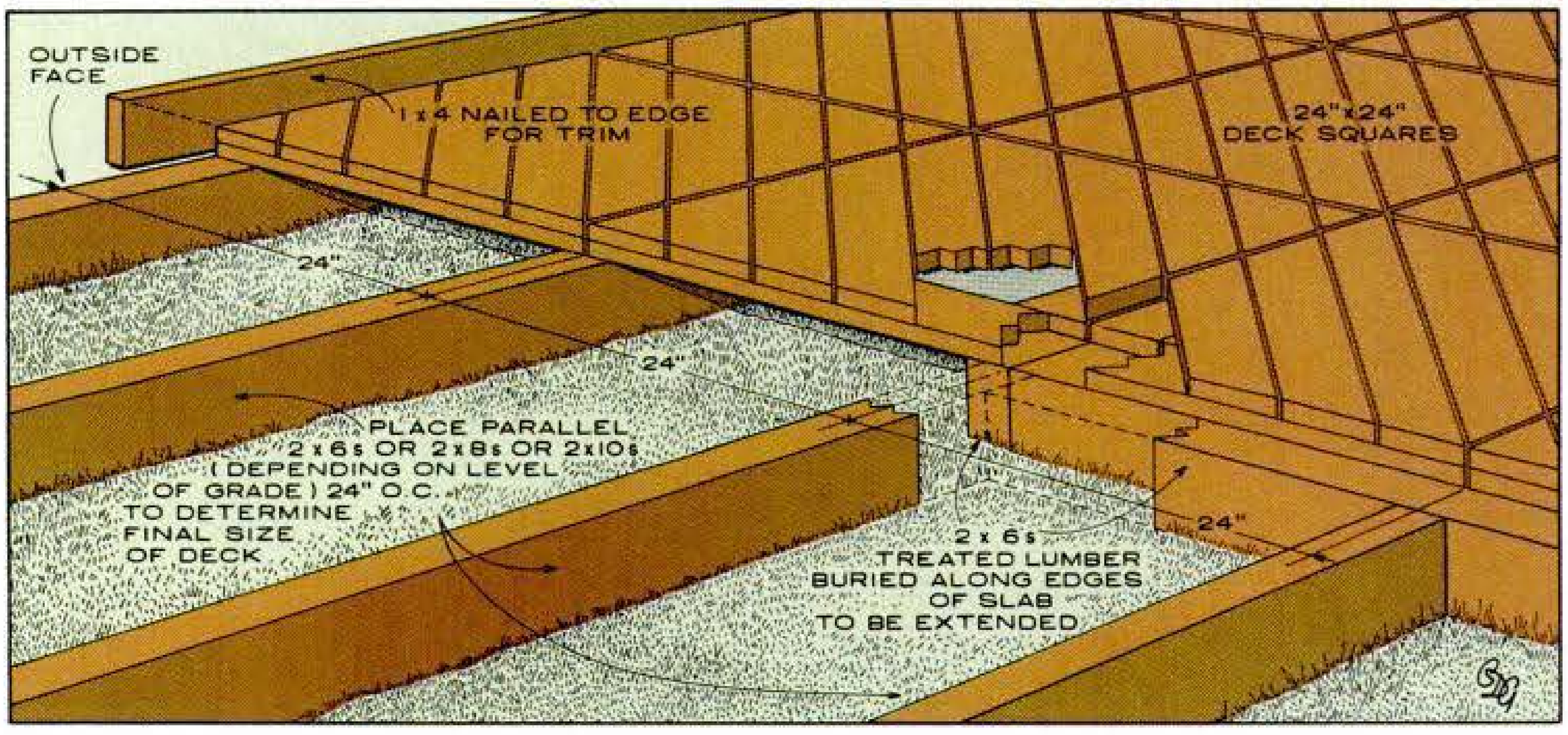
By WILLIAM J. HAWKINS

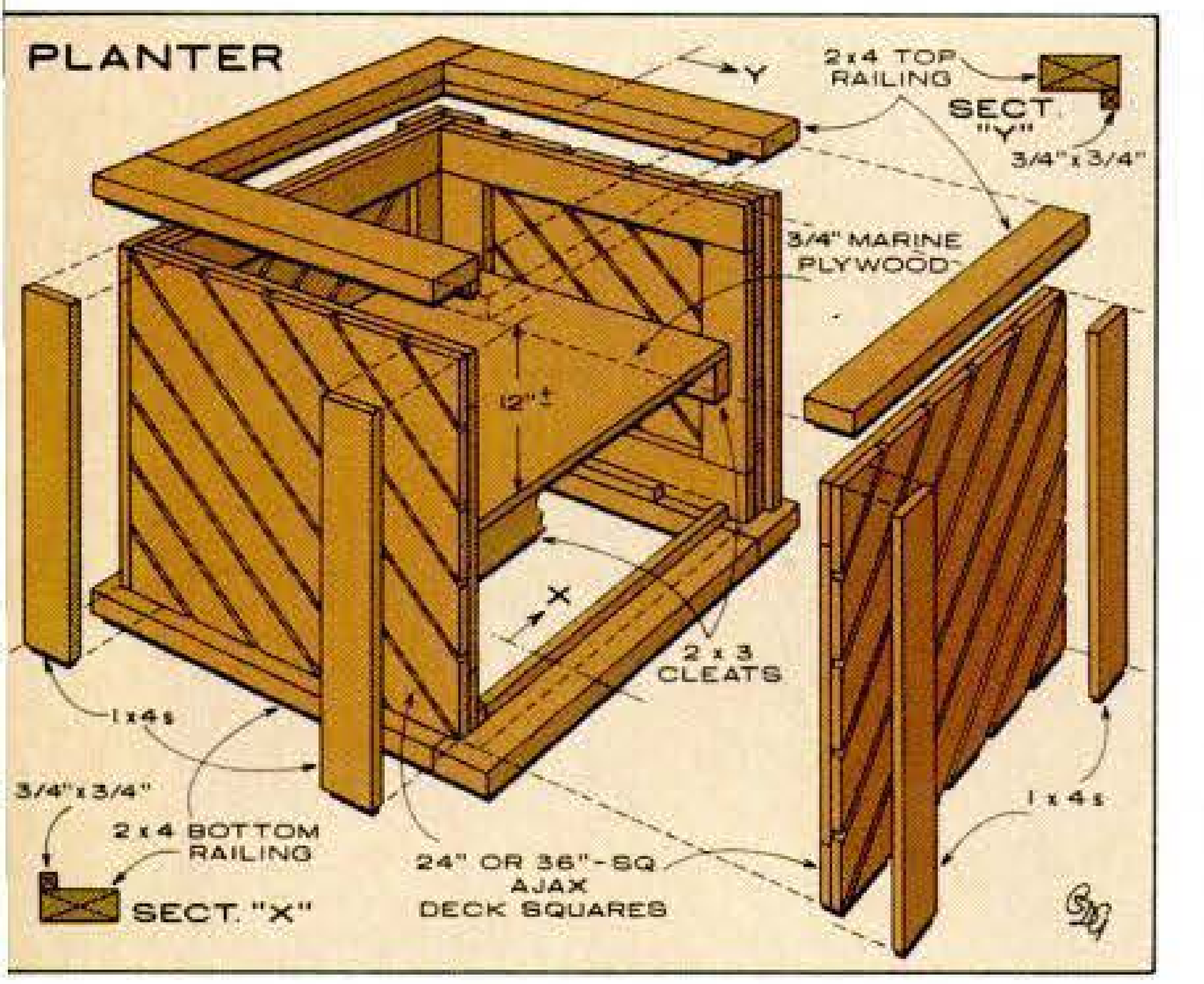
It's almost like laying tiles over an inside floor: Grab a panel, drop it in place, and move on to the next. However, Deck Squares are larger, and the covered area is usually outside your house.

Create a new patio with the squares, or use them to cover an existing slab that's cracked or pitted. "Install a new walkway," says Ken Woodfill, sales manager for Ajax YardWorks, maker of Deck Squares (3325 Ferguson Rd., Fort Wayne, Ind. 46809). "Make a planter, or refinish the concrete floor in your basement." If that sounds like there's a lot left to your imagination, you're right. That's one of the main advantages of Deck Squares.

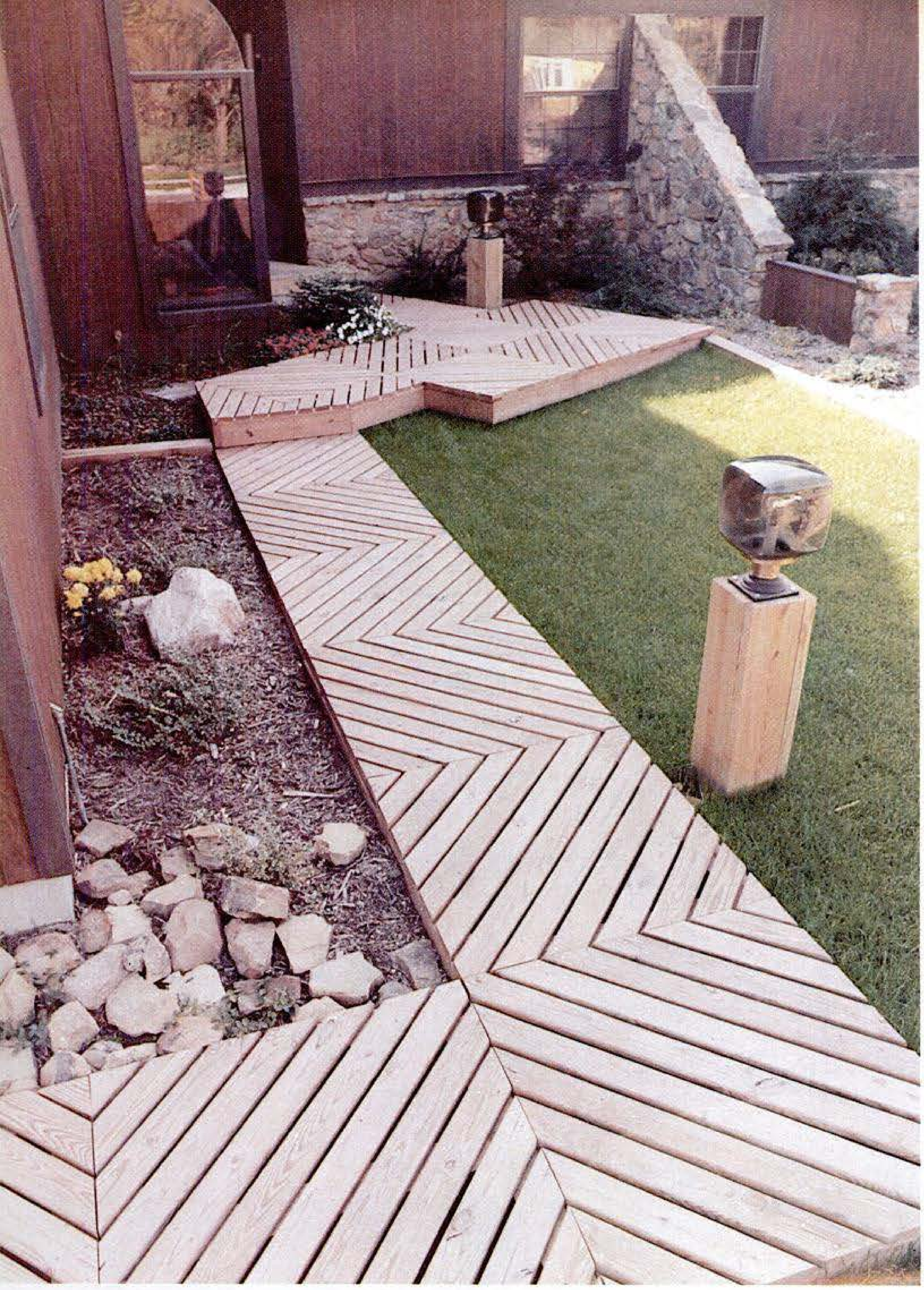
The slatted squares come preassembled in two sizes—two or three feet square—and are pressure treated for a 20-year lifetime with no additional finishing. To cover an old slab, you merely lay the squares on top of the concrete surface. If there's an overlap at the slab edges, trim the Deck Squares to fit. To hold the squares in place, nail a 1 × 2 finishing strip around the perimeter.

If you wish to extend the squares past the slab, add support joists as shown in the drawing below. Place 2 × 6s (for an average-height slab) around the slab's perimeter, and use these boards as the anchor points for the extension joists. The joists are placed in a 24- or 36-inch on-center grid pattern (depending on the size of the squares


OUTSIDE FACE
1 x 4 NAILED TO EDGE FOR TRIM
24"x24" DECK SQUARES
24"
24"
PLACE PARALLEL 2 x 6s OR 2 x 8s OR 2 x 10s (DEPENDING ON LEVEL OF GRADE) 24" O.C. TO DETERMINE FINAL SIZE OF DECK
24"
2 x 6s TREATED LUMBER BURIED ALONG EDGES OF SLAB TO BE EXTENDED


PLANTER
Y
2 x 4 TOP RAILING
SECT. "Y"
3/4" x 3/4"
3/4" MARINE PLYWOOD
12"±
X
2 x 3 CLEATS
1 x 4s
3/4" x 3/4"
2 x 4 BOTTOM RAILING
SECT. "X"
24" OR 36"-SQ AJAX DECK SQUARES
1 x 4s

Flower planter is easily assembled using four Deck Squares and 1×4 trim pieces. Use exterior ply for the shelf; its height in the box depends on the size of the shrub. Multiple planters can be grouped as shown at right.



you choose); Deck Squares are placed on top and held with 2½-inch galvanized nails.

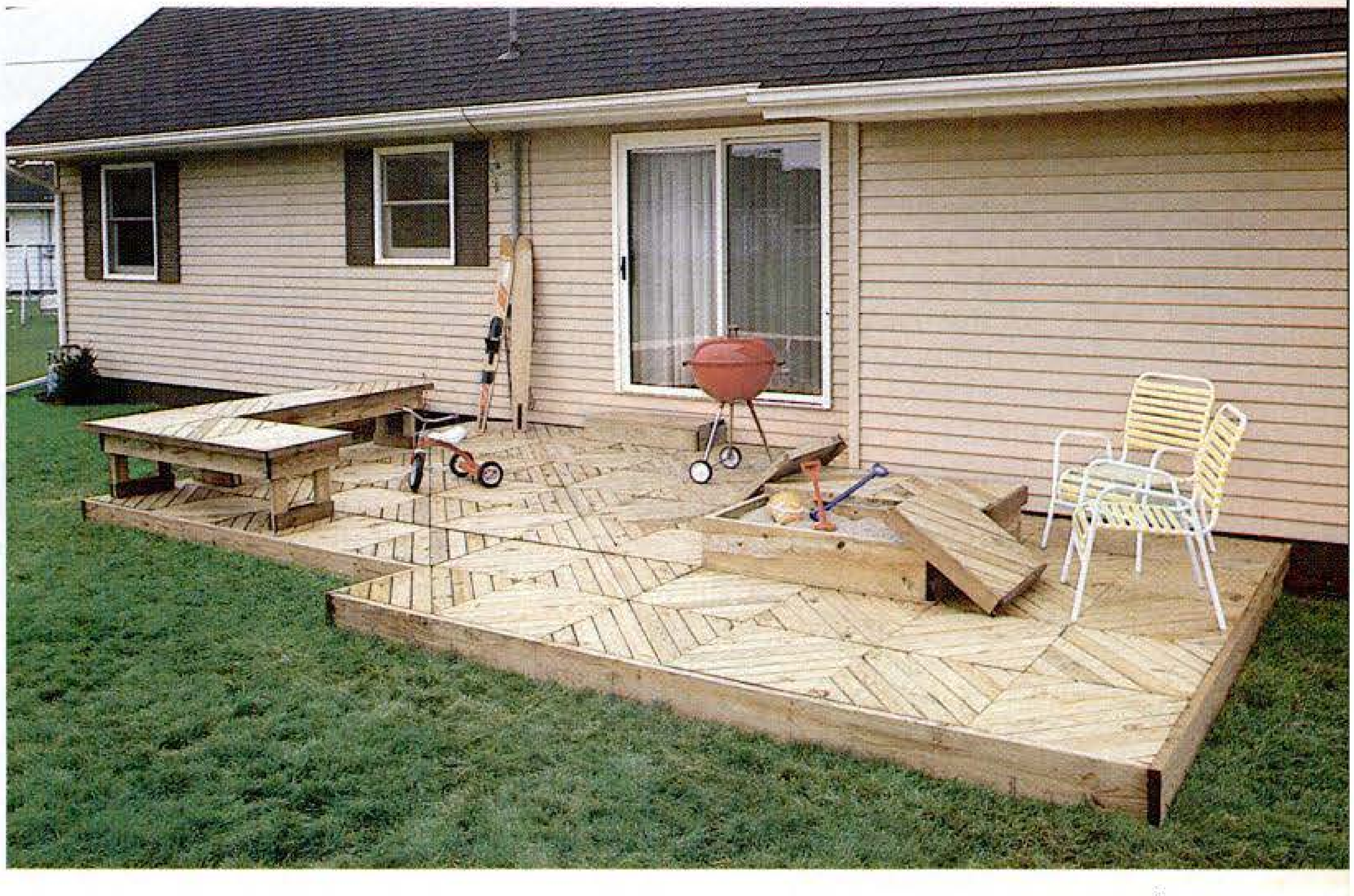
Similarly, a grid pattern of joists is used to create a new patio. (Ajax supplies a grid planning sheet.) Once the joists are installed, the first square is nailed in place at one corner. The edge of the square should cover only half the width of the next joist, allowing room to mount the adjacent square. All squares are butted up tightly against each other; when complete, a 1 × 4 finishing strip is added around the perimeter.

For walkways, a simpler grid pattern is used. However, as shown in the photo at left, steps or different levels can be added by changing the joist height in certain areas.

Although Ajax originally designed the squares for decking, there are lots of other uses. For instance, four Deck Squares nailed together as a box make the planter shown. Four squares mounted on a base of tiered risers make a patio coffee table. The table can be surrounded with benches made of Deck Squares that are supported by a frame of 2 × 6s with 2 × 4 legs. Squares can even serve as a cover for a sandbox, as shown below. The box is made of 2 × 10s with an exterior-plywood base. (Be sure to drill a few drain holes for water in the base.)

Raised decks can be enclosed with squares mounted along the sides. With the addition of hinges and locking hardware, some squares (or groups of squares) become access doors: Now the clutter of yard gear you stow under the patio won't be seen.

Deck Squares are available through local home-improvement stores. A two-foot square is $10; three-foot, $17.



Before and after: Slab patio above was covered and extended with Deck Squares for the result at right. Added touches: Deck Squares table and sandbox with cover. Patio designs can have different levels or steps and need not be rectangular. At top, a step is added to the walkway by increasing the joist height. A cut and re-cleated square creates the angle above the step.

TIPS FROM A PRO—
8 elegant edges from layered laminates

Black & Decker
CUT ROUTER
All Ball Bearing Construction
Wrench Stores In Base
Worklight

IMPROVE YOUR HOME

By A. J. HAND
Photos by the author

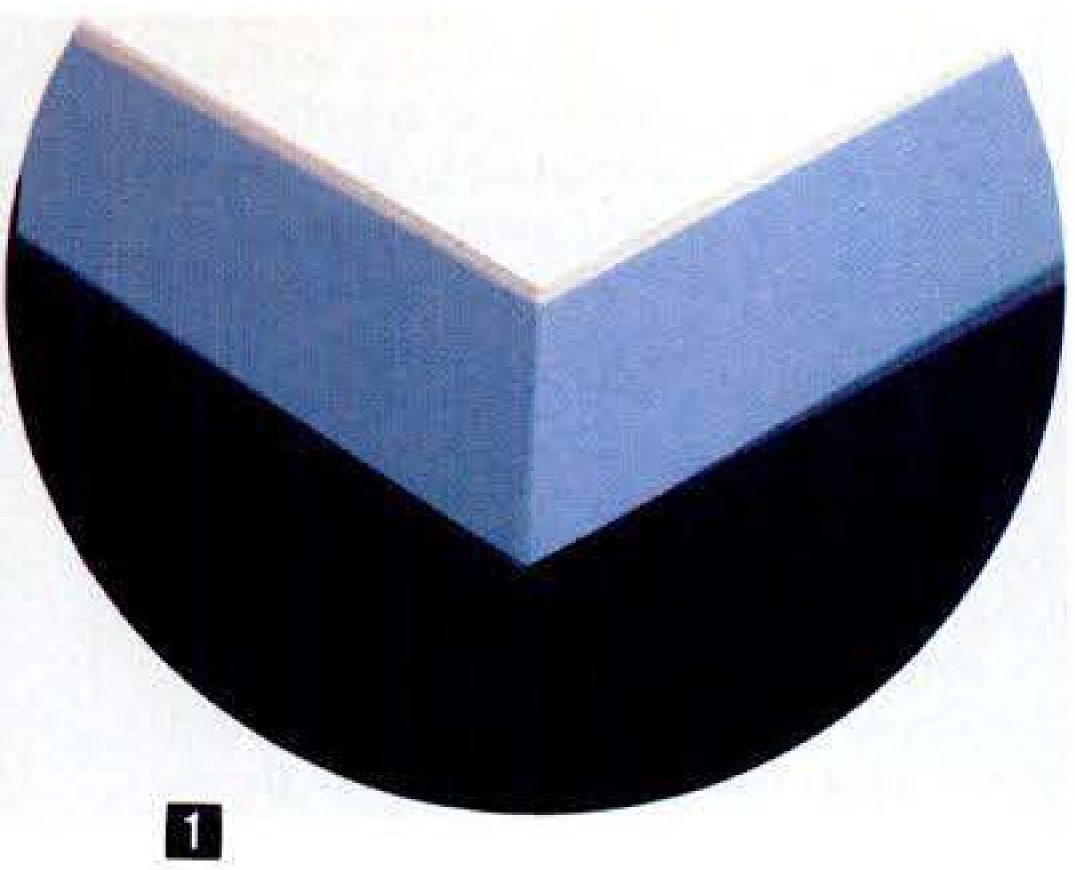
For years, those dark, unsightly lines along counter-top edge seams have been the price you paid for the convenience and durability of plastic laminates. Save for this drawback, laminates provide one of the easiest routes to a professional-looking woodworking project. Simply glue and screw together a few pieces of particleboard to form a core, and cover it with laminate: You can rapidly complete a piece of work as slick as anything you can buy in a store. But still, there are those dark edge-seam outlines to mar the effect. Now things have changed. New laminates with full-depth color and no dark backings make it possible to produce work even slicker than you're likely to find in a store [PS, May '85].

The trend toward "color-through" laminates, whose surface color runs all the way through to the rear of the sheet, started with Formica Corp.'s Colorcore. Then Wilsonart followed with Solicor. And now Pioneer offers a similar product called Pionite Melcor (see listing of manufacturers). There's a premium for these new laminates, though: They cost from two-and-a-half to three times more than the earlier materials.

Originally, the color-through laminates were developed to eliminate those dark lines, thereby improving durability by increasing the thickness of the wear layer of the laminate. Along the way, however, designers have discovered new tricks you can do with the color-throughs to produce eye-catching edge treatments. Some of these techniques are described in the captions. But first, some general points:

Use a low-visibility contact cement when working with these laminates. Formica recommends its No. 100 or 140 cement; Wilsonart, its No. 500. The thickness of the glue line is critical to a neat job, so be sure to apply a thin, even layer of adhesive with a paintbrush or solvent-resistant roller. Also, remember that carbide-tipped tools make cutting much easier. PS

Edge treatments you can make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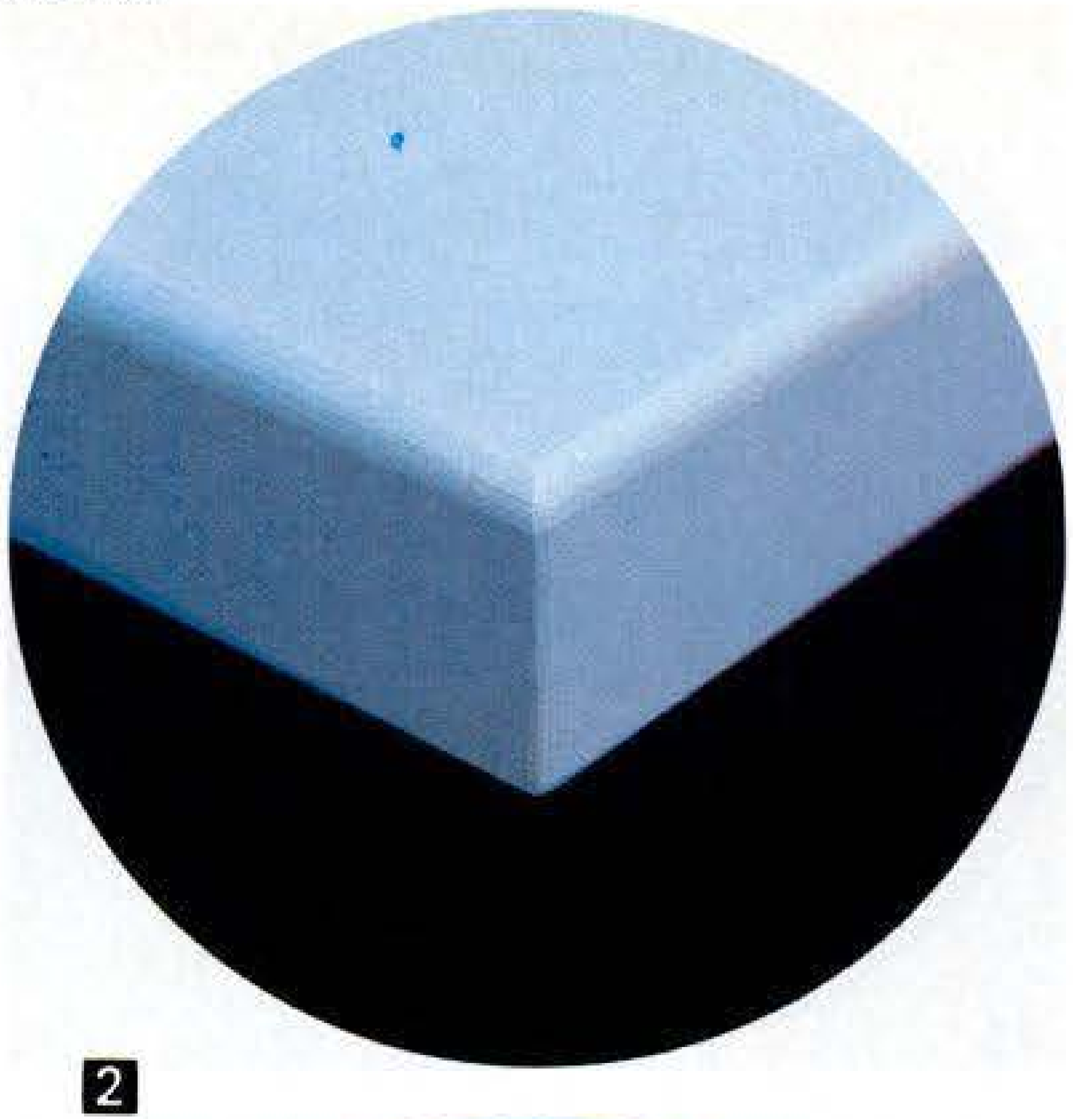
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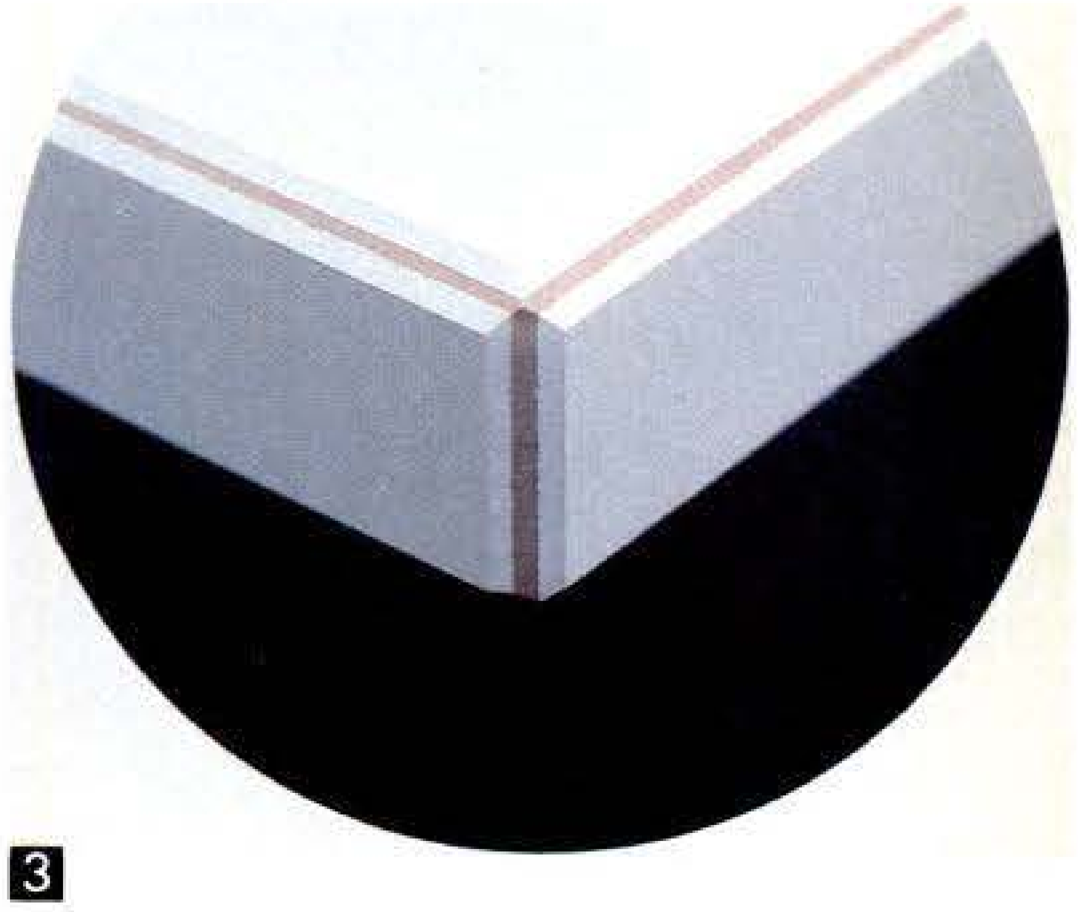
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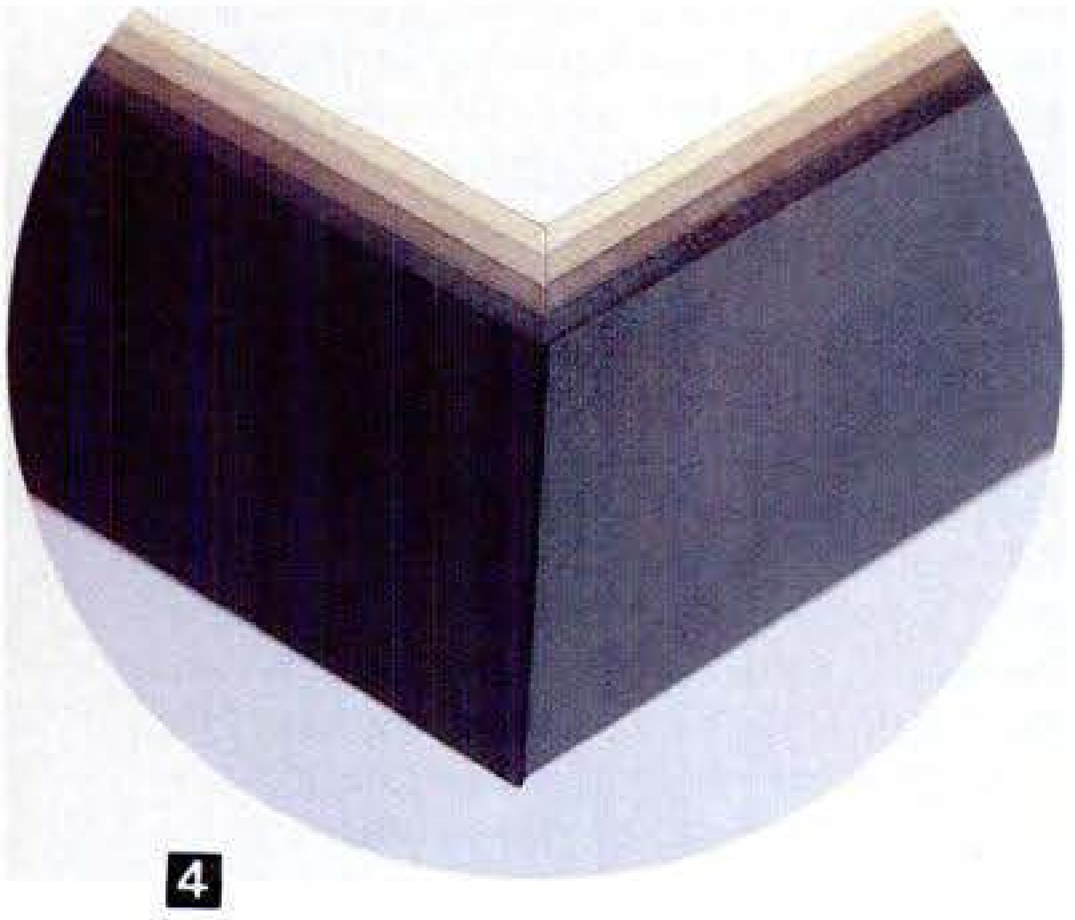
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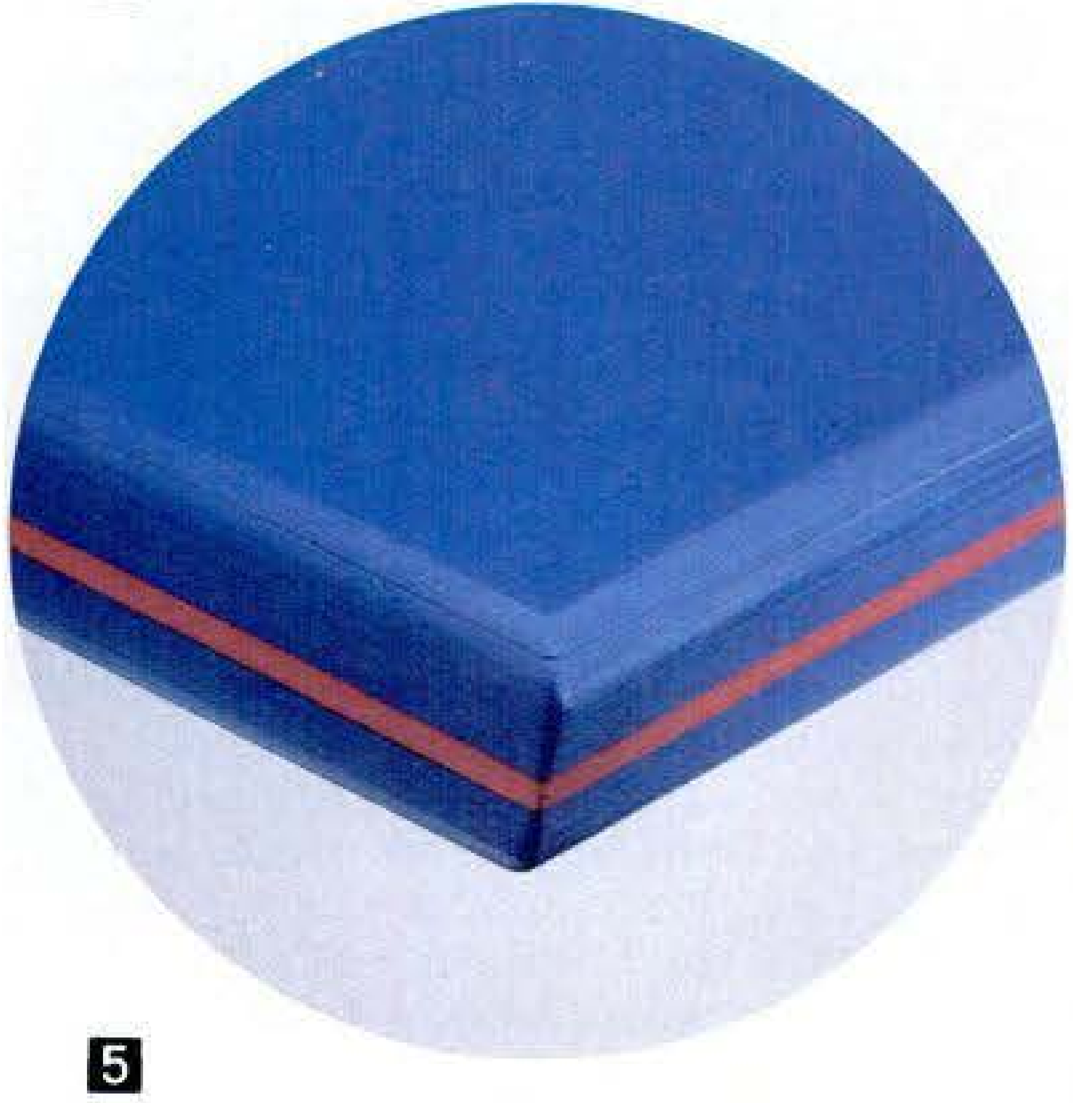
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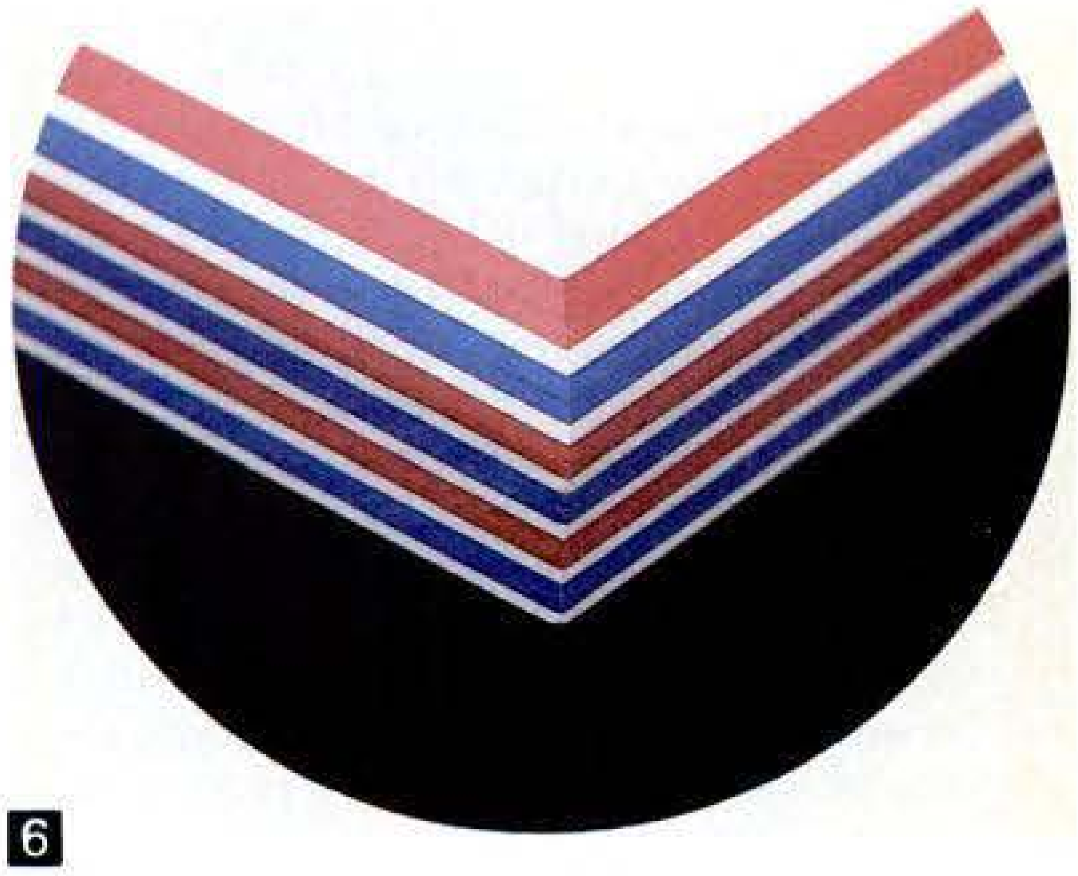
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1 SELF EDGE

The self edge is the simplest laminate edge treatment of all. In most cases you'll use the same color material for both the top and edge banding. For contrast, I used Formica Colorcore in Desert Beige for the top and Cloud Blue for the edge banding.

The first step is to apply the edge banding. Put a double coat of cement on the edge of the substrate, allowing sufficient drying time between coats. A single coat will do for the edge banding. When the cement is tacky to the touch, place the edge banding in position. Trim the banding flush with your router, then fix the laminate to the top with a thin, uniform coat of cement on both surfaces. Position the laminate, and press it down firmly all around. For the neatest seams, apply extra pressure along the edges with a special edge-rolling tool, or squeeze the top down with a clamp and a block of wood to distribute the pressure and protect the laminate. Just tighten the clamp down on the block, release it, slide it along the edge a few inches, and repeat.

Trim the top with a router fitted with a bevel-trim bit, then rub the trimmed edge with lemon oil to restore it to full color and luster.

2 ROUNDED EDGE

You can produce this soft look using the same techniques described for the self edge (1). The only difference is the choice of the router bit used for final trimming. Instead of a bevel-trim bit, use a rounding-over bit with either a $5/32$- or $1/8$-in. radius. Avoid using a bit with a radius larger than $5/32$ in. or you'll cut all the way through the laminate and reveal the substrate. I used Dusty Jade Colorcore for this treatment and trimmed it with a $5/32$-in. bit.

3 PINSTRIPE EDGE

This dramatic edge has a smart, contemporary look, and it's almost as easy to produce as the self edge (1). To start, apply a strip of edge banding in your choice of contrasting color to the edges of your work. Here I've employed Copper Rose Colorcore. Once it is in place, scuff-sand its smooth face with 80-grit paper to improve gluing adhesion. Using the same color as the top, cement another layer of edge banding right over it. Here, it was Silver Colorcore. Now trim both bands with a flush-trim bit. Apply the top laminate as before.

Finally, trim the edge with a 45° chamfer bit. Be sure to adjust the depth setting on your router to get the right effect: Set it too shallow, and you won't reveal the pinstripe. If you set it too deep, you may go all the way through to expose the substrate. It's a good idea to build a small mock-up of your edge treatment with scraps of laminate so you can do some test cuts on it and adjust your router accordingly.

4 SHADED EDGE

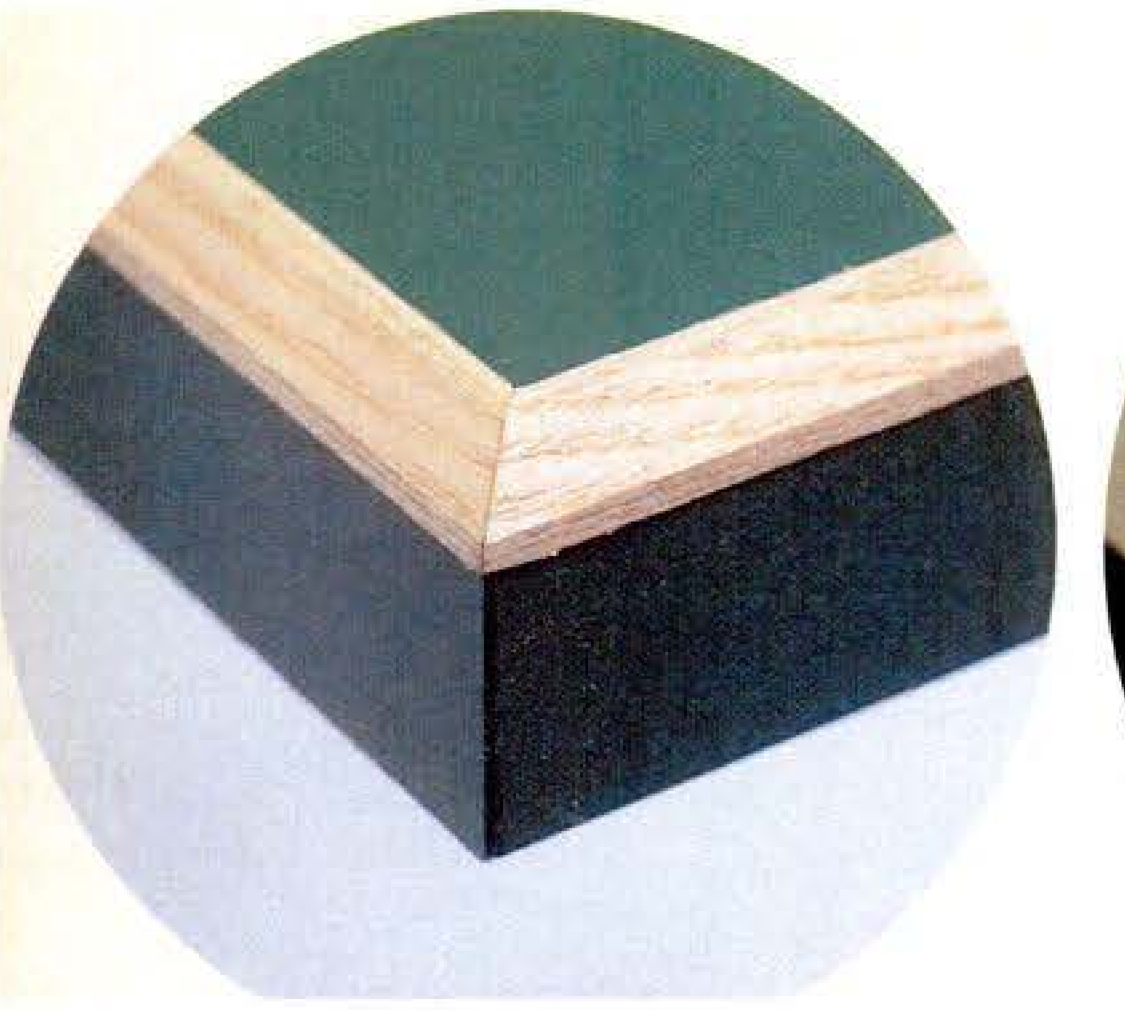
This treatment gradually moves from a light shade at the top through ever-darkening bands in the same color family. For this sample, I started with Colorcore in Vanilla for the top, then graduated through Wheat, Sand, Ginger Brown, and Pumpernickel. There are several ways to achieve this effect, but here's the easiest:

Contrary to normal practice, apply your top laminate first. Next, apply a strip of edge banding in the next-darker shade using contact cement. Scuff-sand the face of this strip, and apply contact cement on the next-darker band. Sand and glue up a third band. Keep this up until all the colors are in place, then trim with a 45° chamfer bit and rub the machined edges with lemon oil.

An alternative procedure is to glue up the edge banding as a complete unit before cementing it to your work. This saves time because all strips can be glued at once—and all dry at the same time. Just scuff-sand all but the outermost layer of edge banding. Apply cement to mating surfaces, let them dry, and then assemble them.

The *drawback* to this technique is that you'll have to miter the banding units where they meet at corners. Applying the strips one at a time allows you to use simpler overlapping joints. You can also use a clear epoxy instead of contact cement. This can create very tight, invisible seams between strips, and it

Continued



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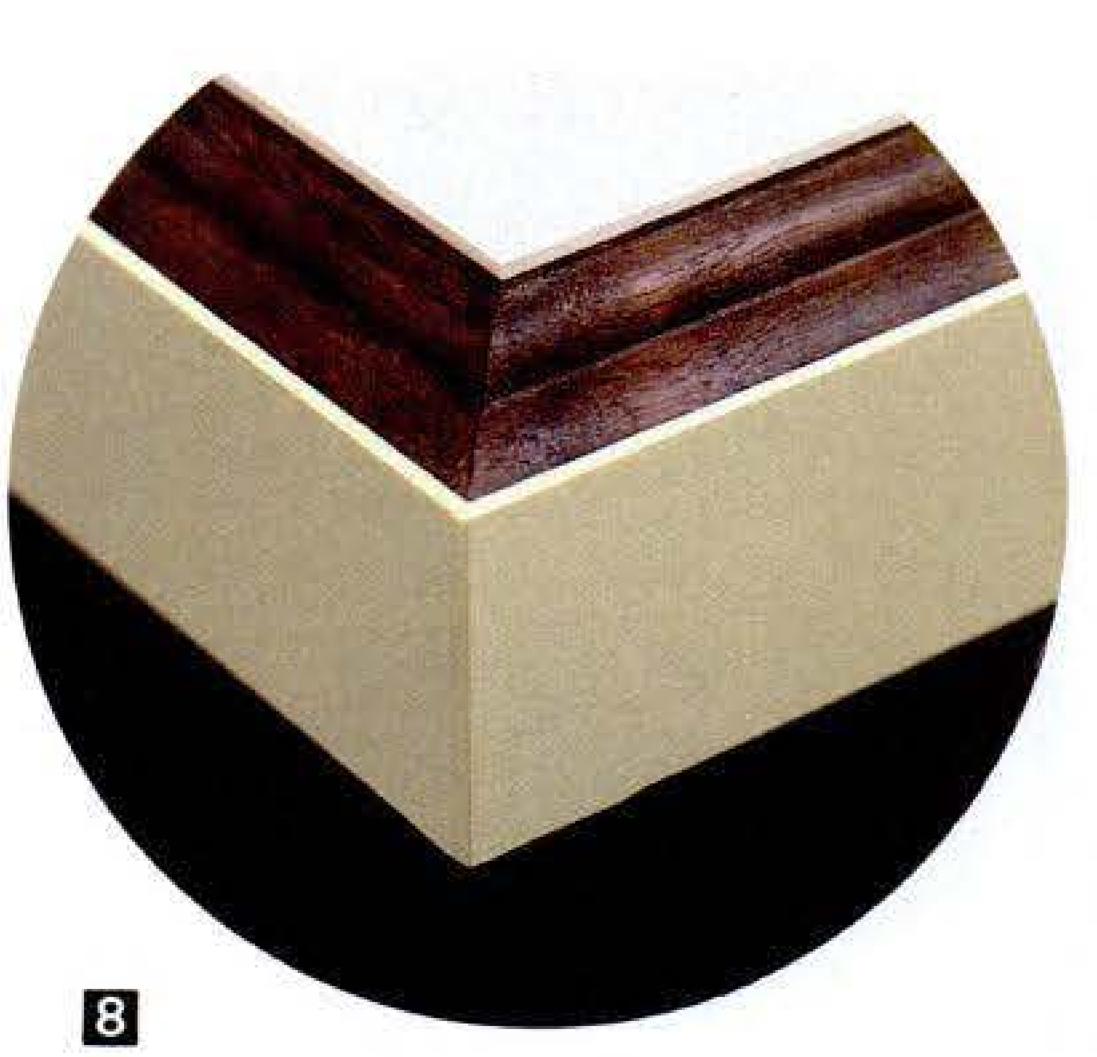


8

also requires great care and dozens of clamps.

5 BULLNOSE PINSTRIPE EDGE

Be prepared for a lot of work to create this striking edge. To start, determine how many layers of laminate it will take to build up to the desired thickness of your work. I used 12 layers of Spectrum Blue Colorcore for this job, plus two layers of Spectrum Red, and wound up with edge banding ¾ in. thick. Note that this thickness does not include the layer of blue for the top. Once you have determined the number of strips required, rip them about 1 in. wide on a table saw. Scuff-sand all smooth faces to increase adhesion, then contact-cement the strips into a neat stack. True up the stack by trimming about ⅛ in. off both edges on your table saw. A good triple-chip carbide blade works best for cutting this stack.

Cut the finished edge-banding stack to the necessary lengths, miter any corners, and cement the pieces in place. Make sure to keep the top edge of the stack flush with the top edge of your work. An easy way to do this is to place your work face down on a smooth surface and simply slide the edge banding into position, forcing it down tight against the work surface.

Once the edge banding is in place, install the top sheet of laminate. Then trim the edge—top and bottom—using a rounding-over bit. Here, I used a ⅜-in.-radius bit, about right for the finished work thickness. Rub the machined edges with lemon oil.

6 CANDY-STRIPE EDGE

The possible color combinations for this treatment are endless, but here I used a bright blend of Colorcore in Spectrum Red, Spectrum Blue, and White. The procedure is exactly the same as for the bullnose pinstripe (7), except here you finish off the edge with a larger ½-in.-radius rounding-over router bit.

7 CHAMFER FILLET EDGE

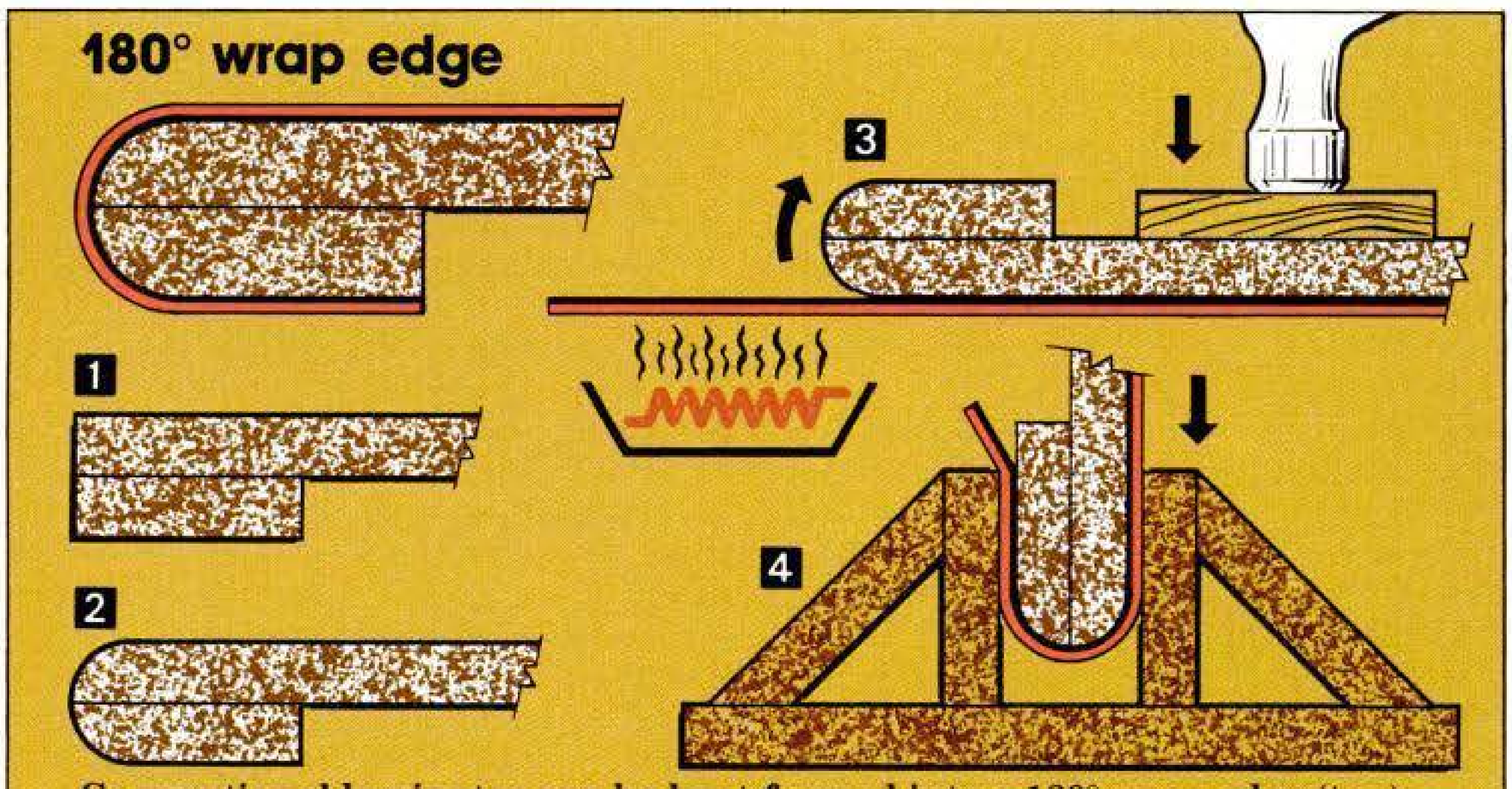
This treatment puts the rich accent of hardwood along the edge of your work. If you do it as shown here, you won't even need to use the more costly color-through laminates. Conventional laminates will work just as well because the edges of the sheets remain covered.

Laminate the edges and top as described for the self edge (1). Then take a ⅜-in. ball-bearing rabbet bit and set it to cut a ⅜-in. square rabbet. Make a test cut on a scrap of wood to check your settings, and then cut a rabbet into the top edge of your work. *Important*: If you cut this rabbet in the usual manner—feeding the router against the rotation of the bit—you will almost certainly chip the edge banding. Instead, start by taking a very light cut while feeding the router *with* the bit rotation. In other words, feed the router from right to left as you face your work. This cut need only be deep enough to penetrate the laminate. Also, don't try for a full cut, or the router will dig in and run on you. Just make a light pass. Then turn around and feed the router against bit rotation in the usual manner to complete the rabbet without fear of chipping.

Once the rabbet is cut, glue ⅜-in.-square strips of hardwood into the rabbet with white adhesive. Miter the strips at all corners. When the glue is dry, trim the hardwood fillet with a chamfer bit. If you'd like a softer edge, you can use a rounding-over bit. For this example, I used Hunter Green Formica and an ash fillet.

8 FORMED HARDWOOD EDGE

This elegant edge can be created with any of a variety of router bits. I used a "classical" bit here, but an ogee, cove, roman ogee, or rounding-over bit will also give good results. To begin, glue a strip of hardwood (I used walnut) to the edge of your work. Trim it flush on top with a flush-trim bit. Then apply edge banding (Wheat Colorcore here) in the usual manner. Next, laminate the top (I used Vanilla Colorcore). Finally, rout the edges using the edge-forming bit of your choice. Finish the hardwood with two or three coats of tung oil. *Note*: If this type of edge becomes damaged, you can renew it by rerouting it with your bit set a fraction of an inch deeper.



Conventional laminates can be heat-formed into a 180° wrap edge (top): 1) attach the particleboard strip to the bottom of the counter-top edge; 2) round off the edge, then apply contact cement to bonding surfaces; 3) position the counter top on laminate, leaving enough excess for wrap, apply pressure, and heat the laminate to 313° F; 4) slide the assembly into the forming fixture (made of scrap), remove it, and trim the edges.

Strips of laminate for a stacked edge banding are laid side by side for application of clear cement with a brush.

SOME MAKERS OF PLASTIC LAMINATES

Formica Corp., 155 Rte. 46 W., Wayne NJ 07470; **Pioneer Plastics**, Div. of LOF Plastics Inc., Pionite Rd., Auburn ME 04210; **Wilsonart** (Ralph Wilson Plastics Co.), 600 General Bruce Dr., Temple TX 76501 produced on thin metalized-plastic sheets by a high-pressure-stamping process. The holograms are then embossed onto the cards by a specially modified hot-stamping machine. If someone tries to peel off the hologram, the image is ruined.

The images are unmistakable: Anyone who looked at a fake would know it instantly. And they would be almost impossible to duplicate without advanced equipment similar to that used by ABN. "They're the highest-quality holograms around," said Terence Gallagher, president of ABN holographics. "We're making it difficult for anyone to copy them."

Two of ABN's first customers were Visa and MasterCard, who a few years ago were looking for a way to stop counterfeiting of their cards. It was too easy for counterfeiters to forge credit cards: They needed only a supply of plastic and an embossing machine. It was so easy that the two companies were losing about $40 million a year to fraudulent cards.

The holographic technique developed by ABN looked like the solution. Anyone who has received a new Visa or MasterCard within the last year can see why. Every new card contains an almost impossible-to-copy hologram. The program is working, and the credit-card companies are pleased with the results, according to Richard Roule, marketing director for ABN. "They were losing money. It's saving them millions of dollars," he says.

Uncle Sam is scared

Perhaps the biggest anticounterfeiting project in history is coming to a head. And the product that needs protection is the one most people think about when they hear the term counterfeit: money. The U. S. Treasury Department is worried about the development of a new generation of color-copying machines that will soon be on the market. They will make it easy for unscrupulous office workers to copy U. S. bills with incredible accuracy.

To meet this problem, the treasury awarded $1.7 million to ABN and $4.1 million to Xerox Corp.—an experienced printer of currencies and a leading color-copier maker—to develop techniques for putting holographic images on U.S. currency. ABN is adapting its holographic process for stamping onto paper money, while Xerox is developing a new holographic method that produces a two-dimensional image called a multiple-diffraction grating. A thin strip of the material would be embossed along the edge of a bill, and it would not be reproducible in a color copier. If someone tried to make a color copy, the hologram would appear as a muddy brown area.

American currency has had problems even before the new color copiers. "U.S. currency is the most counterfeited in the world," says ABN's Roule. "It's the easiest to counterfeit because it's only two colors, green and black. And there aren't enough security measures. They're serious about changing," he adds.

And with the new generation of copiers on the way, the need has become urgent. "They have to do it within the year," says Roule. "The copiers are available now."

The proof is in the label

Another system now available produces a label that has the appearance of a hologram—but isn't. It's made by Polaroid Corp. in Norwood, Mass., and is called Polaproof. Polaproof labels are thin, flexible polyester tags. When you move them back and forth, the viewing angle changes and you see several images—logos, trademarks, etc.—alternately flashing in and out. The material is a spinoff of Polaroid's instant 35-mm transparency process. The label is made of two layers. The top layer is a sheet of plastic that has been inscribed with a brass roller that is carved by a special diamond engraving tool. The roller forms very fine lines into the plastic—1,500 per inch. That transforms each inch into 1,500 tiny cylindrical plastic lenses. This lens structure is bonded to a layer of photographic gel. Then the logo or other marking is created in colored lines by focusing light through the cylindrical lens pattern onto the specially treated gel and then developing the gel.

This complex process creates hundreds of colored lines in perfect registration with the lenses. When you change the angle of the label while looking at the finished product, the colors change rapidly as the lines and lenses go in and out of phase. At some angles one logo disappears and another seems to magically pop into view. Different effects can be achieved by varying the spacing of the lenticules and shifting their orientation. Although Polaproof labels now being used are read by eye, a laser scanner has been developed to count the lenticular frequency at high speed.

It would be difficult for a counterfeiter to make a Polaproof label. "For someone to copy our labels, they'd have to have a hundred million dollars worth of machinery and twenty years of research and development," said Walter Pettway, marketing director for Polaproof. "The Japanese came to our plant to find out how the process

Continued

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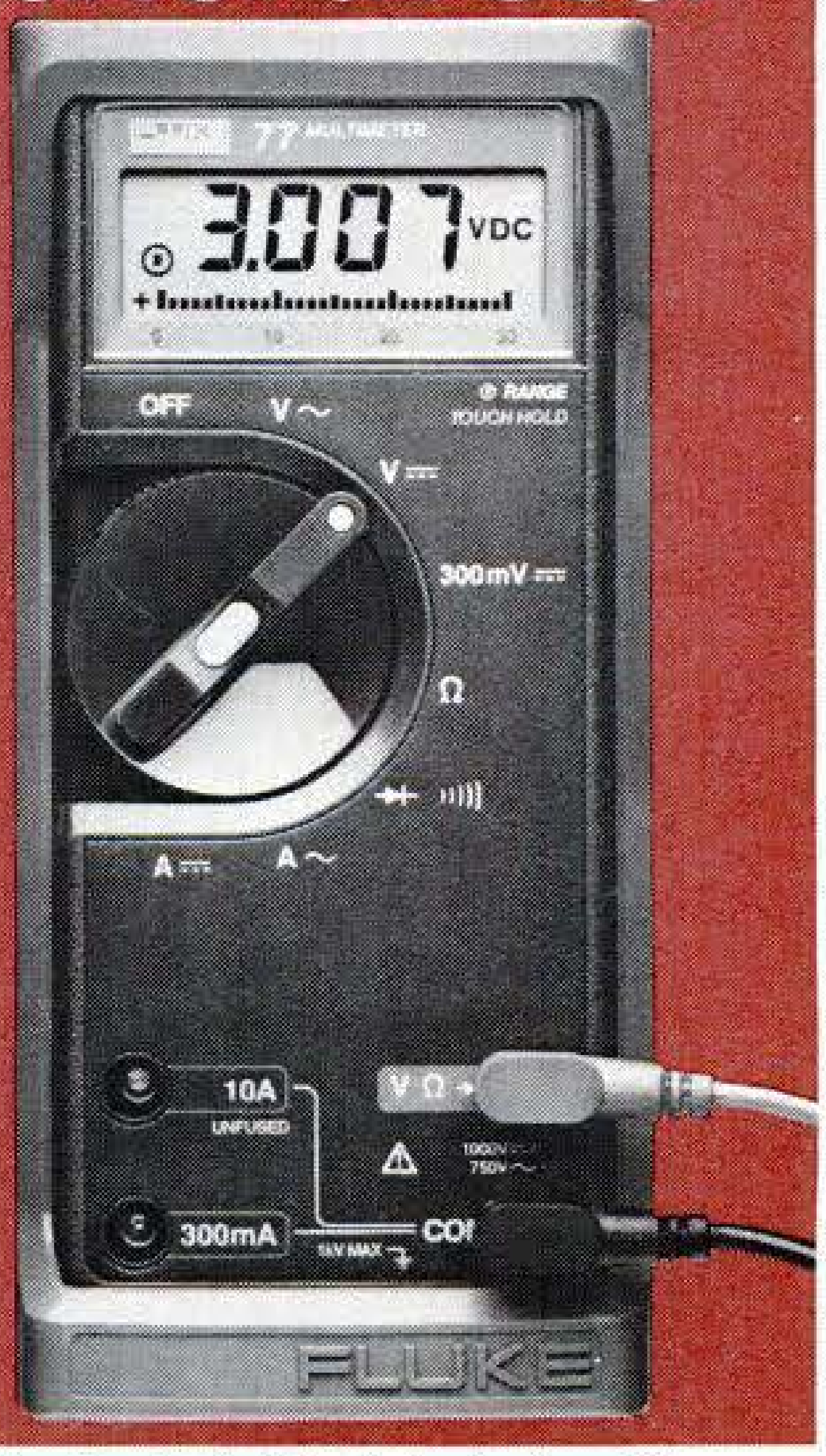

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works," said Pettway. "They looked at it and said 'We can't do that.' Then they offered to buy it from us."

Atari, Rolex, RCA/Columbia, MGM/UA, the Chicago Transit Authority, and the Spanish government use the Polaproof system.

Most companies in the fledgling anticounterfeiting field base their work on one proprietary technology, but a recent entry offers at least three. Veritec is a new company in Calabasas Park, Calif., that went public in October 1985. When it did, 2½ million shares of the firm's stock sold out in four hours.

The enthusiasm for the company stems from the three methods of protection Veritec offers, which can be used alone or in combination. The first, called Visicheck, produces labels that look ordinary at first glance. But look at them under a magnifying glass, and you see hundreds of tiny half spheres spaced in an extremely regular pattern. The company says the spheres are made of metalized plastic. To check the authenticity of a label, you look at it through a viewer that looks like a magnifying glass but isn't. It's a plastic lens that contains a pattern of very fine spheres. Move the viewer over the label, and the interaction of the two produces a series of dancing spheres, lines, and patterns that is unique.

Exactly how this works is not clear. And the company is not too helpful with its explanation. "The lens enhances the image, adding the other half of what the brain sees," said Veritec's vice president and co-founder Robert Anselmo. The pattern of the three-dimensional spheres can be varied in up to 30 colors.

Veritec's second security method involves liquid chemical compounds that can be mixed into inks, paints, or ribbons used in printing labels. Pass the compounds under an ultraviolet light, and they fluoresce. The chemicals' compositions can be varied and increased in complexity, and the $7,000 to $10,000 scanners can scan up to 24,000 items an hour on a conveyer belt.

The third method involves labeling products with units of black and white squares called Vericodes (see photo). They seem simple but can be arranged in an almost infinite number of patterns. Each item is assigned a unique code, which can contain a large amount of information about the product, such as where and when it was made, its composition, and its pricing data. The information is stored in computer memory, and the codes are read by computer-driven scanners. Vericodes can be applied by ink-jet or dot-matrix printers, or they can be laser-etched onto the product. Anselmo calls Vericodes "the bar codes of the future," claiming that the amount of information that could be coded into a ⅜-inch Vericode would require a six-foot-long bar code.

The number of clever anticounterfeiting schemes being developed seems almost endless:

- Microtrace, Inc., of Minneapolis, Minn., has developed a system in which microscopic plastic chips are embedded in a product. Each chip is composed of colored layers that can be detected under a microscope. They also fluoresce under ultraviolet light, and a metal layer can be added to make them magnetic. The technology grew out of founder Richard Livesay's research in developing taggants for explosives while working for 3M Co.
- 3M Co. makes a tamper-proof reflective sheeting called Confirm—a laminated layer of microscopic glass beads—which is used on driver's licenses in New York and California.
- Armstrong World Industries makes an iridescent reflective coating, called Reflectolon, used on transit passes in Newark, N.J.; Philadelphia, Pa.; and elsewhere.

Armstrong has also developed a process called IDenticard, a means of protecting ID cards with a special chemical coating that turns orange, green, and transparent when viewed at different angles.

- Another new company is Telstat Communications Systems, in Birmingham, Ala., which keeps track of products using an IBM main-frame computer, following them from the manufacturer through the distribution chain. Through special audio-response equipment, consumers can provide marketing information by calling a number and touching single digits on a push-button phone.

What's next?

A growing number of companies are turning to the new anticounterfeiting systems for help, including the major U.S. auto makers, who have been plagued by counterfeits of practically every part in their cars. Although they haven't chosen a system yet, Chrysler, Ford, and General Motors Corp. are all looking at anticounterfeiting technologies to solve their problems.

Many of the anticounterfeiting technologies now going into use have emerged during the last five years. It's uncertain how long they'll last and how successful they'll be. Meanwhile, more methods are being developed. "You can't hang your hat on one peg. You have to keep on evolving more devices," says ABN's Roule. PS

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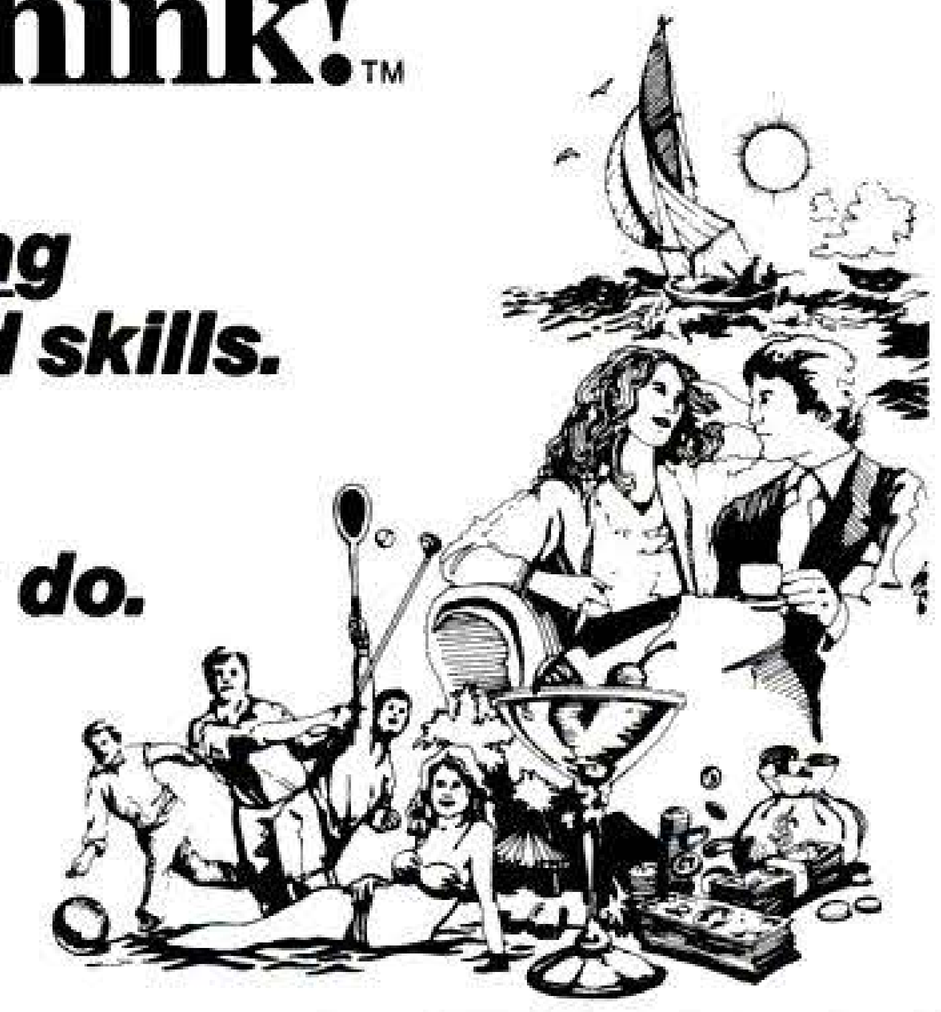

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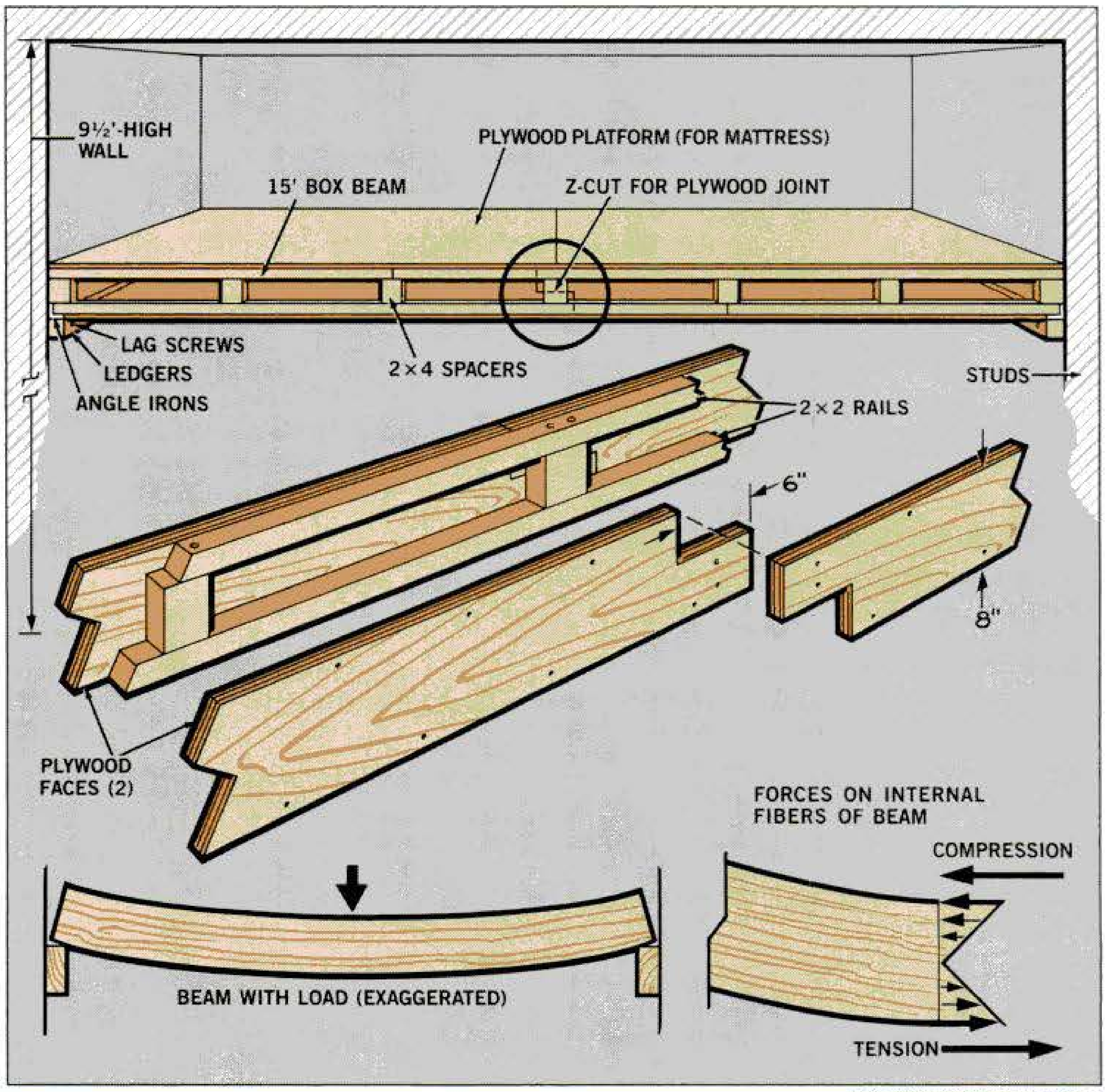


DRAWING BY GERHARD RICHTER

As an engineering student sharing an apartment, I needed more space. My 15-foot-wide bedroom has 9½-foot ceilings, so I designed a loft to bridge the walls. To get maximum floor space, I decided to use just two box beams to support the entire span of the loft (see drawing above).

My friends told me it wouldn't work, but I knew that a box beam, which uses the same principle as an I-beam, could handle the stress imposed on it. Bending under the load (see drawing) compresses the inner fibers of the upper part of any beam, creating pulling force, or tension, on fibers on the underside.

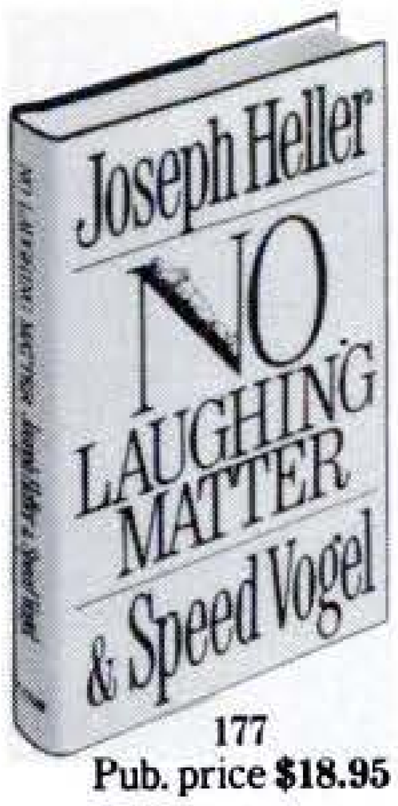
The fibers between the top and bottom layers undergo comparatively little strain and thus contribute little toward the overall strength of the beam. In a box beam, you eliminate the center material (see drawing) to produce an inexpensive, lightweight beam that's sturdy for its size. These versatile box beams can support a deck or patio as well as a loft, and could even help raise a sagging garage ceiling.

To make the beams, I first cut the plywood faces to size. Because the beam had to be more than eight feet long and I could only obtain an eight-foot plywood sheet, I notched the joints with a six-inch Z-cut as shown. Next, I cut upper and lower rails and internal spacers to length. I laid one plywood piece facedown and positioned the rails and spacers on it, making certain I staggered any rail joints so they wouldn't line up vertically or with the plywood joint. I glued and nailed the rails and spacers to the plywood using a subfloor adhesive (other high-strength glues could be used) and spaced nails every 12 to 18 inches. Then I flipped the assembly over and attached the other plywood face.

To construct my loft, I fastened the box beams with angle irons to ledgers that I lag-screwed into the studs. I then fastened a plywood platform to the beams. To prove the beams' strength, I had six of my friends climb up and bounce around on the platform. It supported all six of them easily, and didn't sag more than ½ inch at the center.

—Kurt. A. Kreutzmann

Which of these books have you been meaning to read?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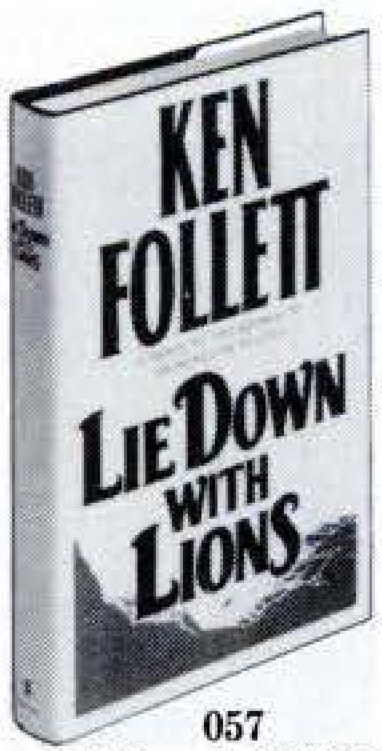
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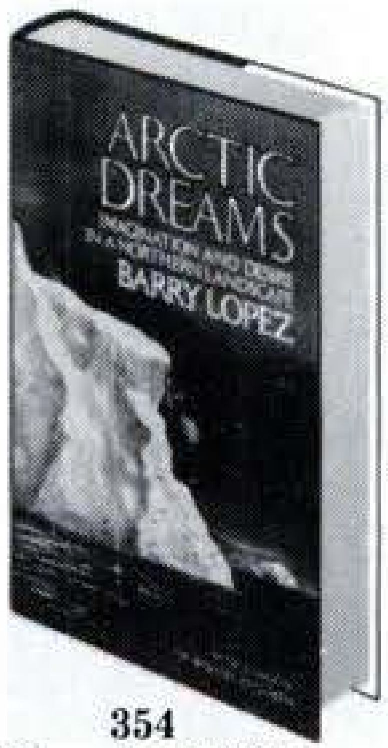
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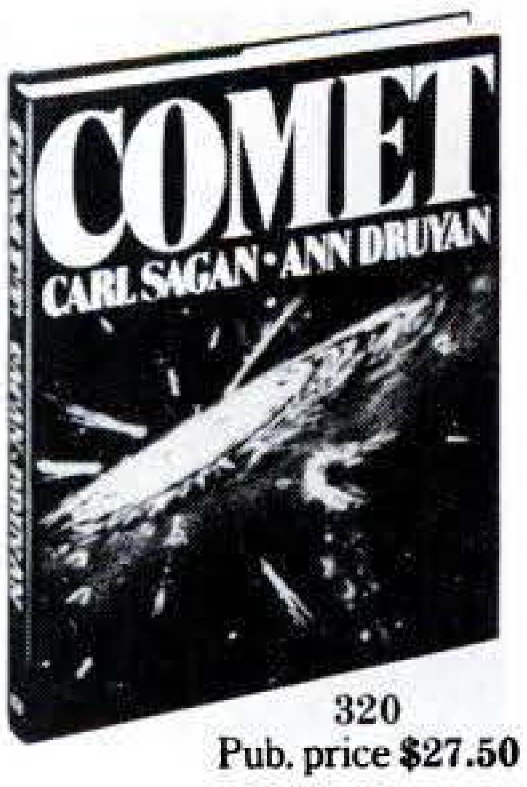
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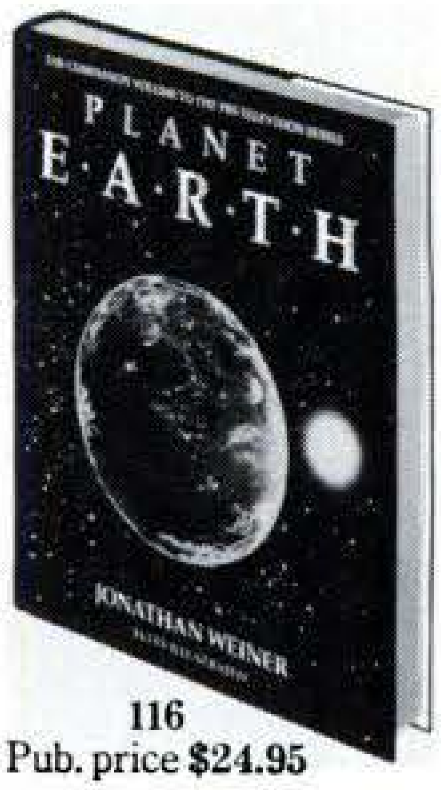
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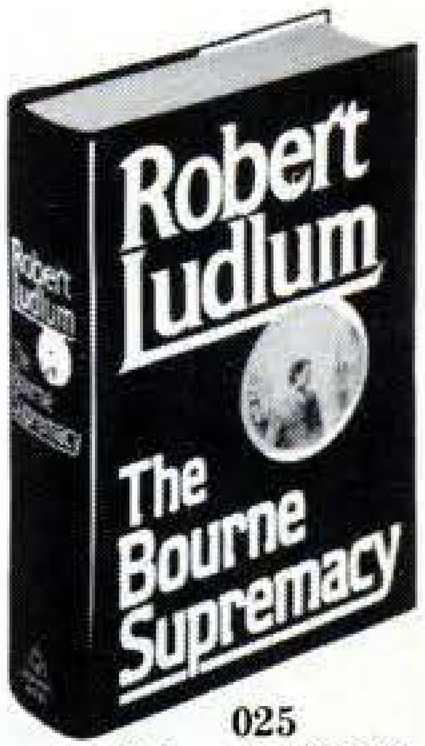
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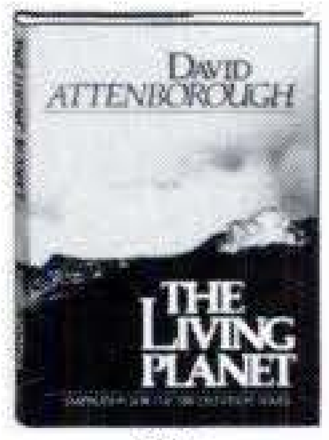
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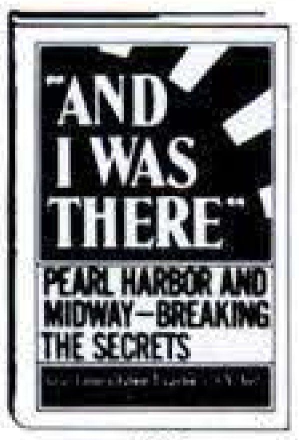
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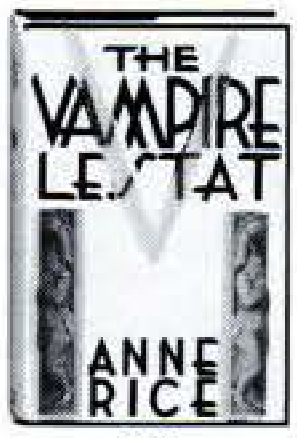
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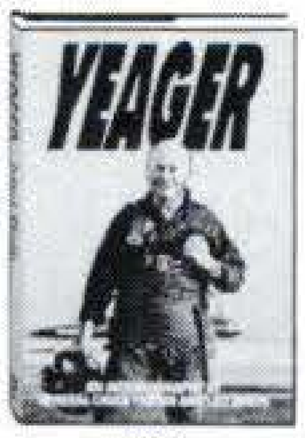

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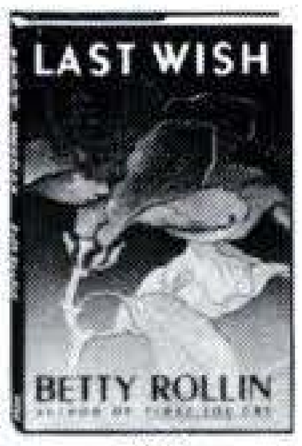
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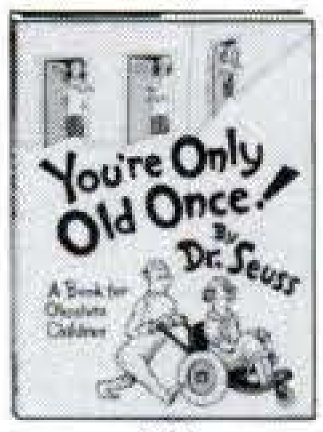
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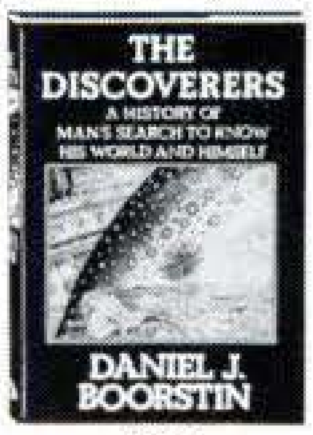
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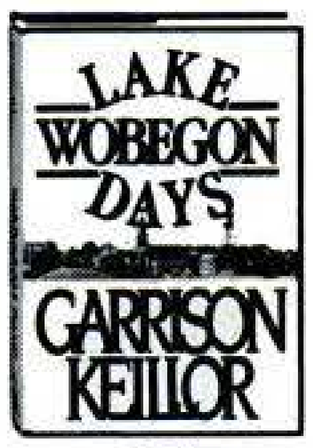
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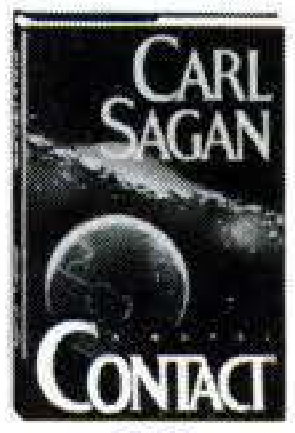
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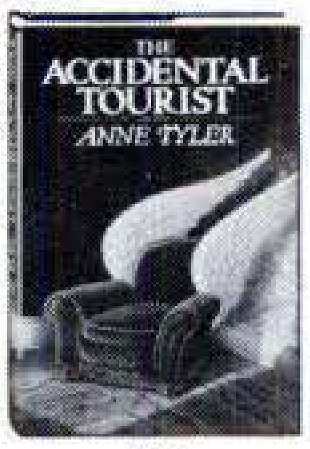
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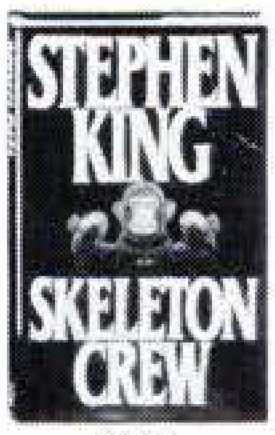
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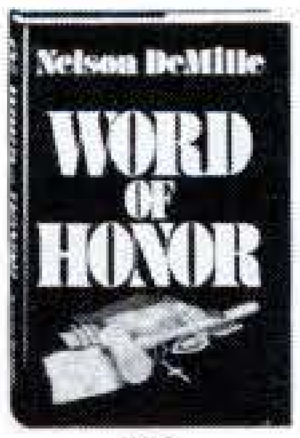
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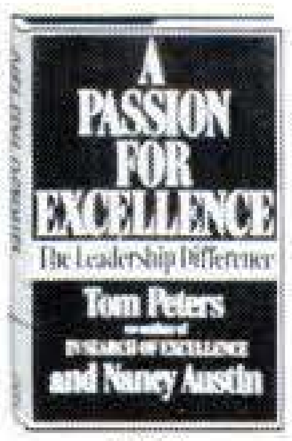
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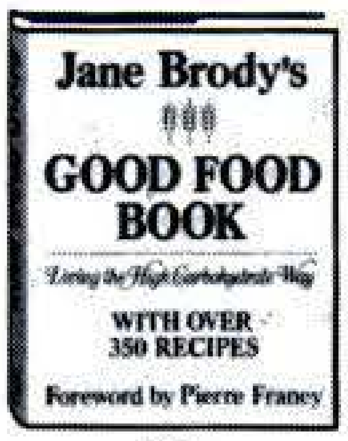
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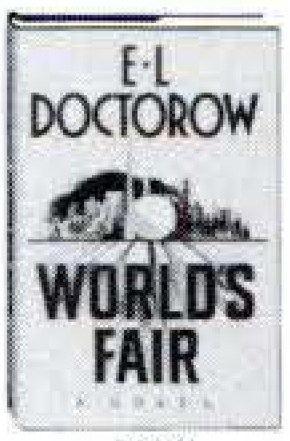
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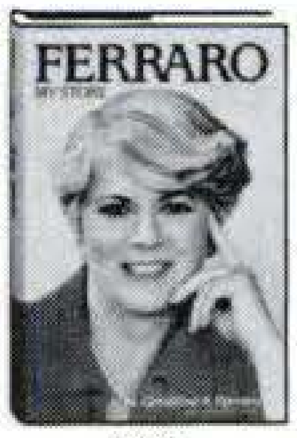

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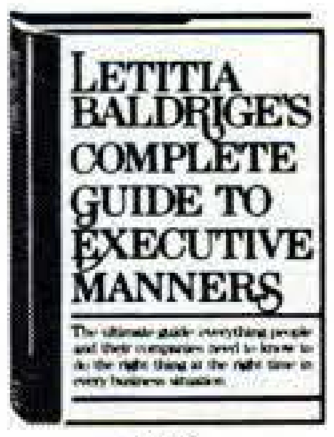
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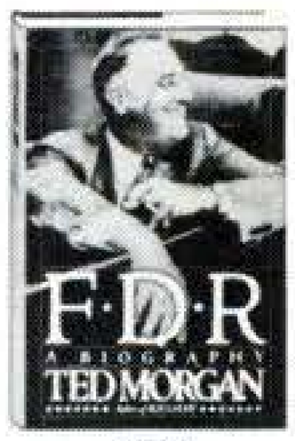
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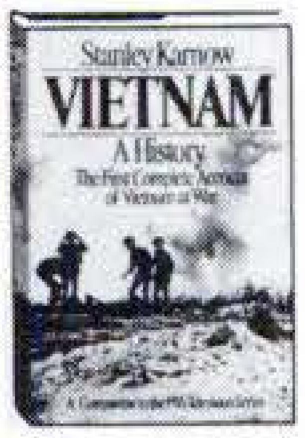
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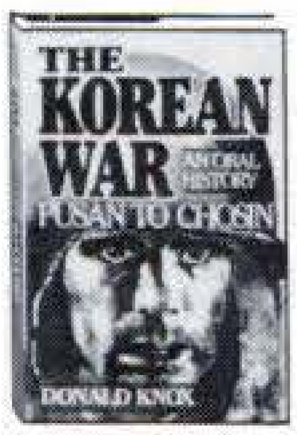
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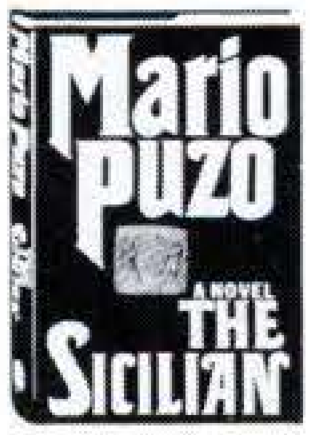
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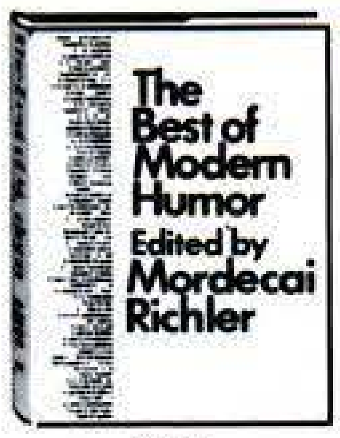
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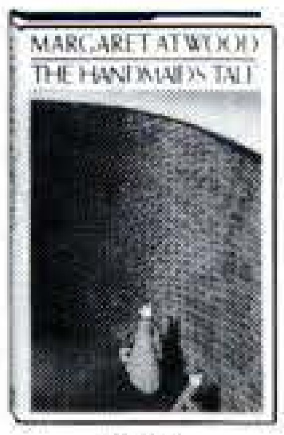
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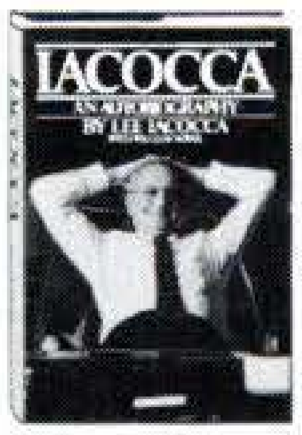
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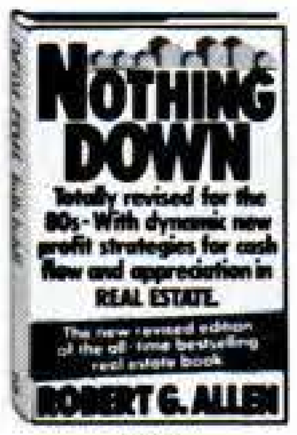
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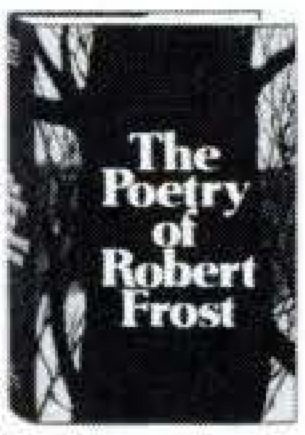
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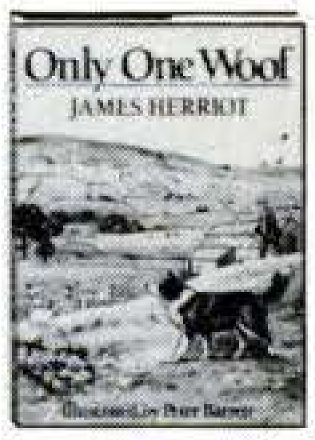
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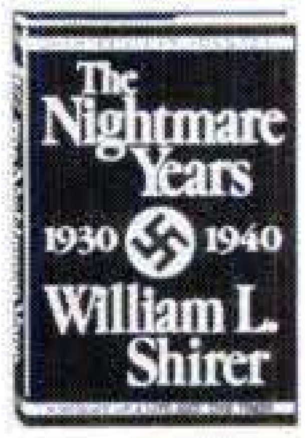
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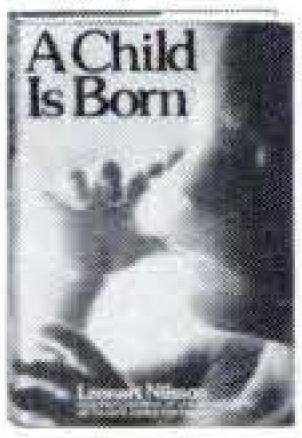
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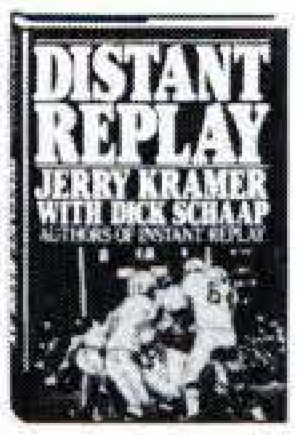
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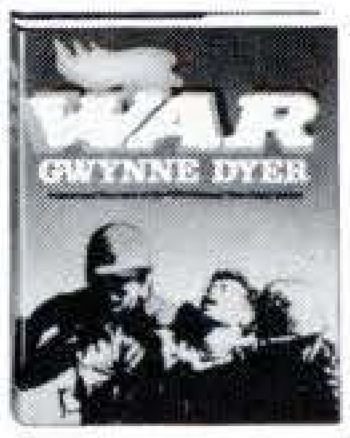
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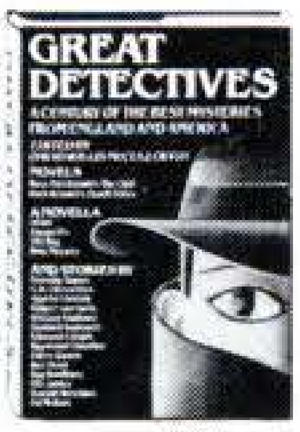
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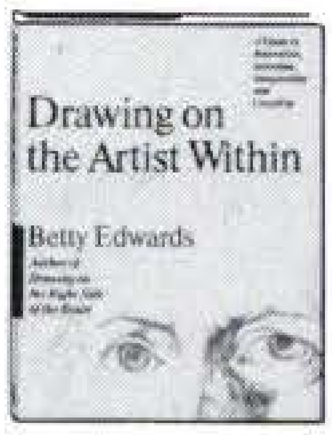
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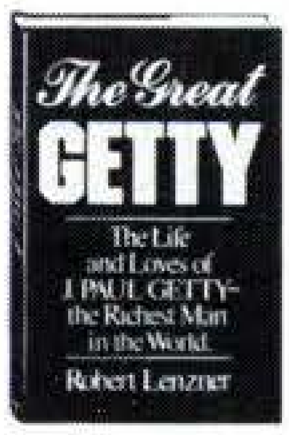
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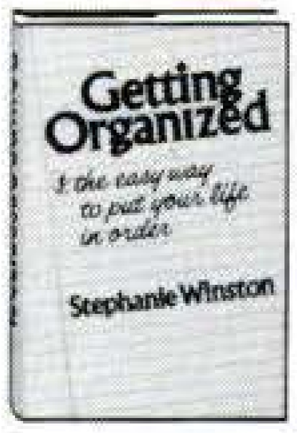
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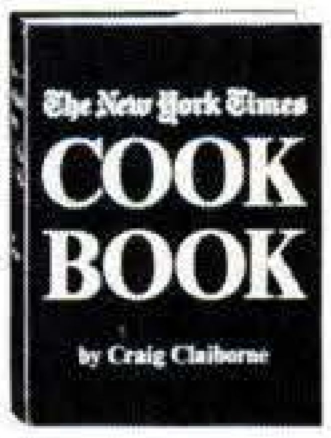
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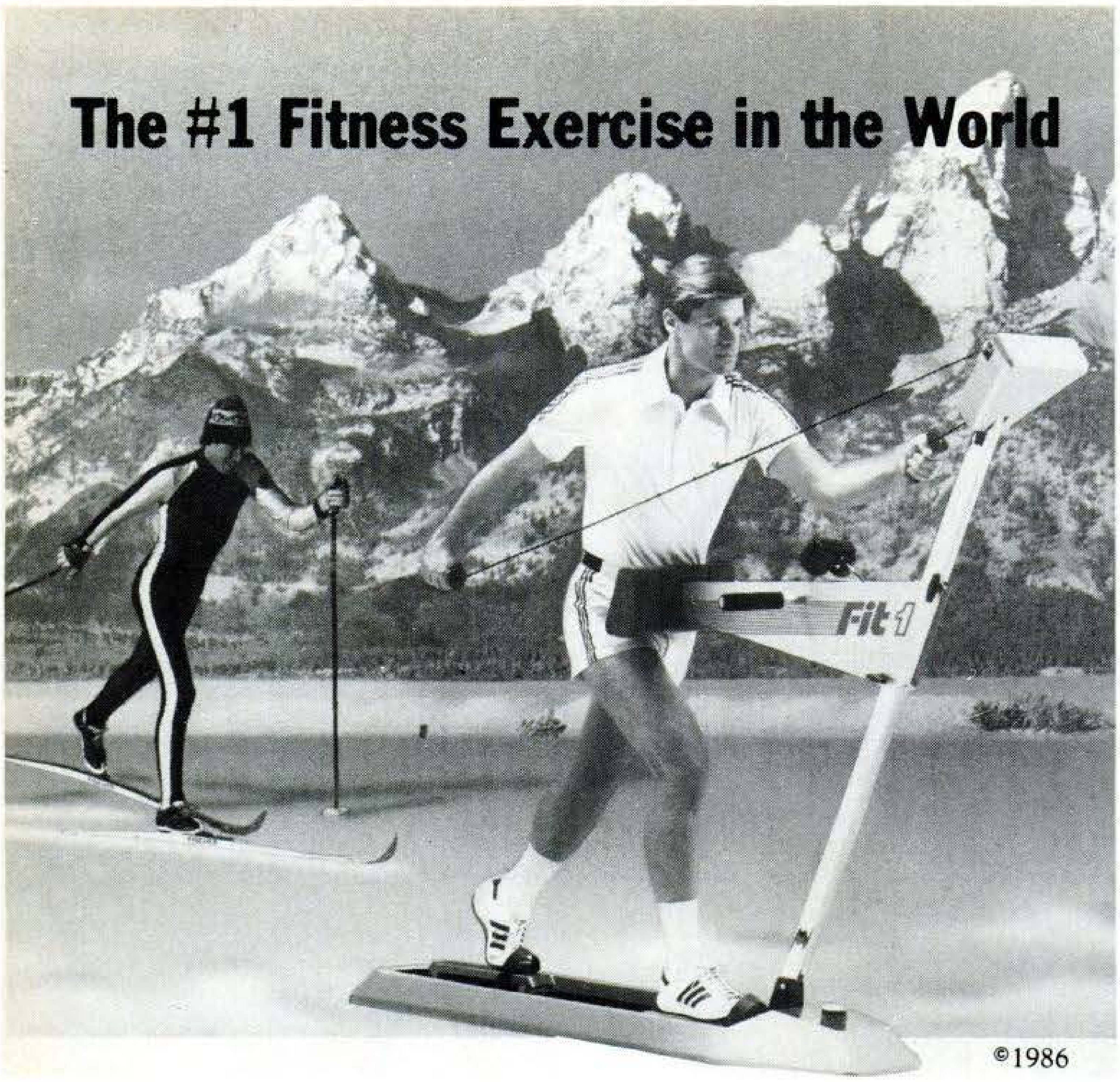
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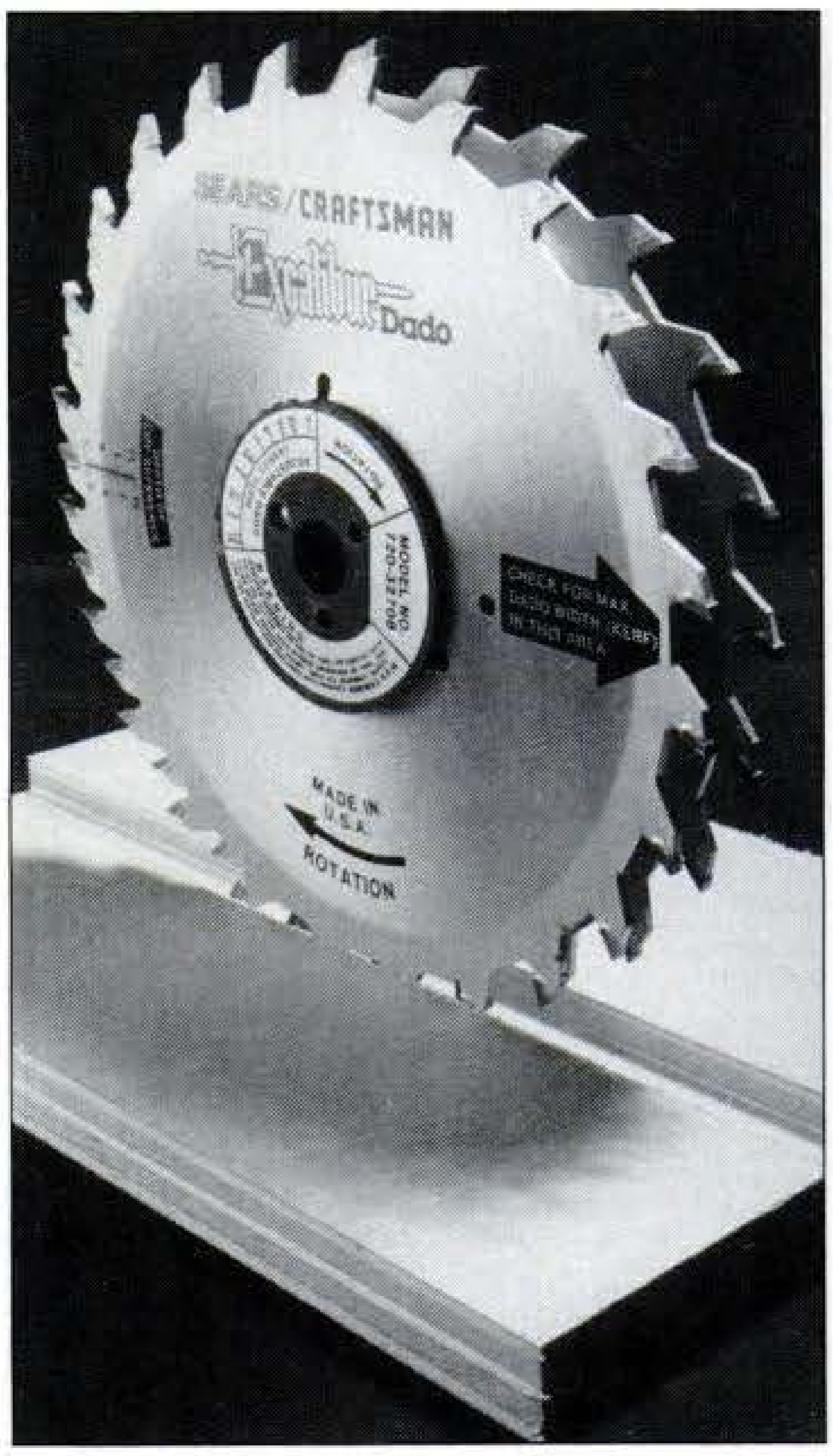
Twin-blade dado



Blade's center dial adjusts the cut width from ¼ to 1³⁄₁₆ in. Slots in the hub change the wobble angles of the twin blades when the dial turns.

For years I've relied on carbide-tipped wobble-type dado blades. A wobbler is cheaper and easier to adjust than a conventional chipper-style dado head, which must be disassembled for width-of-cut changes. Any disadvantages? Wobble dadoes tend to vibrate, which prevents the blade from cutting perfectly true-edged dadoes.

Now there's the $100 Excalibur wobble dado from Sears, which minimizes vibration troubles. How? Instead of a single blade wobbling from one side of a dado cut to the other, Excalibur uses twin blades. Each one wobbles just from the center of the cut outward, which reduces its wobble angle by half and improves its dynamic balance—it produces truer, cleaner cuts. Some other advantages:

- Excalibur is eight inches in diameter (most other dado blades are six or seven inches). This allows deeper cuts—up to 2½ inches on some saws.
- There's a depth-of-cut scale printed right on the blade.
- The farthest-offset part of the dado is marked in black, making it easy to check the width of the kerf and to set your saw fences and stops correctly.—*A. J. Hand*

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KLM introduced the FIRST satellite TV receiver system for consumers! They designed the FIRST programmable receiver. KLM is one of the largest in the industry and is a leader in advanced technology. Because they are concentrating efforts on new designs, KLM has allowed us to offer a quantity of these current 8-ft. models to the public at an unusually low price! It's a tremendous value!

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- ***Includes 120 feet of cable!***
- ***Superior quality throughout!***

BRINGS UP TO 100 OR MORE TV CHANNELS INTO YOUR HOME!

REMOTE CONTROL
Operates Aimer IV (shown at right). Push-button access to 64 programmed satellites. 6 pre-sets for your favorite programs.

Does not include metal support pipe.

It opens up a vast new world of TV entertainment! MORE sports! MORE movies! MORE of everything you like to watch! And it provides superior reception capabilities!

The KLM 8-ft. Satellite TV Receiver system picks up signals from more than a dozen communications satellites in the sky. This opens up over 100 channels of TV viewing, with a multitude of programs. And the KLM system provides outstanding reception capabilities throughout the entire 48 states!

PERFECT FOR SPORTS FANS! Enjoy much more sports action and thrills than ever before! You'll literally be "in heaven" with the vast selection of football, baseball, basketball, hockey and many other exciting televised sporting events to choose from.

HUGE VARIETY OF ENTERTAINMENT. Watch popular new films and plenty of classic "oldies" on the movie channels. Keep up with fast-breaking national and international events, any time of day, on all-news networks.

Get important investment "tips" and information from the financial/business channels. View provocative Adults Only programs. Delight in video entertainment of top performers on music channels for rock, pop, country, classical, etc.

PLUS, there are entertaining and educational channels specifically for children. Religious and cultural channels. French and Spanish networks. The list goes on and on! And with each new TV satellite placed in the sky, your exciting world of home entertainment keeps growing LARGER and LARGER!

IDEAL FOR RURAL AREAS! If TV reception is poor or the variety is very limited where you live, you're in for a HUGE DELIGHT! With the KLM system, reception is as good as in a big city. And the variety is huge!

GREAT FOR URBAN AND SUBURBAN AREAS! With the KLM system, you can still pick up all your usual local stations. PLUS, you get greatly expanded selection from all the satellite channels. There's a huge world of viewing pleasure in store for you. Up to 100 or more TV channels are available with the KLM system!

DO-IT-YOURSELF INSTALLATION! You don't have to be an electronics "whiz" to install the KLM system. Components come pre-assembled, except for the 8-ft. "dish." Need: 3½" outside dia. support pipe, bag of cement mix and your own TV. KLM has a Toll-Free number to call just in case you need assistance. The "dish" is designed to withstand high winds.

AN EXCELLENT VALUE! Don't be fooled by someone else's "low" price on a "dish" that is SMALLER than ours...NOT as high-tech...or is INCOMPLETE and requires costly purchases of additional components. With our KLM 8-ft. "dish" you get a complete, superior quality system from a leader in the industry...at a remarkably low closeout price!

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Uncomplicated, easy operation! Fast fingertip selection of channel, polarity, audio tune. Relative signal strength meter lets you hit station right on the button. Separate AFC on/off selector allows precision tuning, even of weak channels.

INCLUDES blockdown converter (an expensive option on competitor's models). This splits signals so 2 TV sets in your home can "tune in" on 2 different channels of same satellite at same time. However, you need another receiver (available from regular KLM dealers) for the second TV set.

HORIZON TO HORIZON MOUNT

This special mount delivers maximum degrees of "dish" rotation for access to TV Receive Only satellites in western hemisphere. 120 feet of cable also included.

Fully Programmable AIMER IV REMOTE "DISH" POSITIONER

Microprocessor controlled for pushbutton access to 64 pre-programmed satellite locations. Six pre-sets for favorite satellites. Automatically positions "dish" and channel skew (polarity). Battery backup for three-month memory retention in case of power failure or for unplugging system during vacations. Parental Lockout prevents children from viewing restricted channels.

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By ROY DOTY

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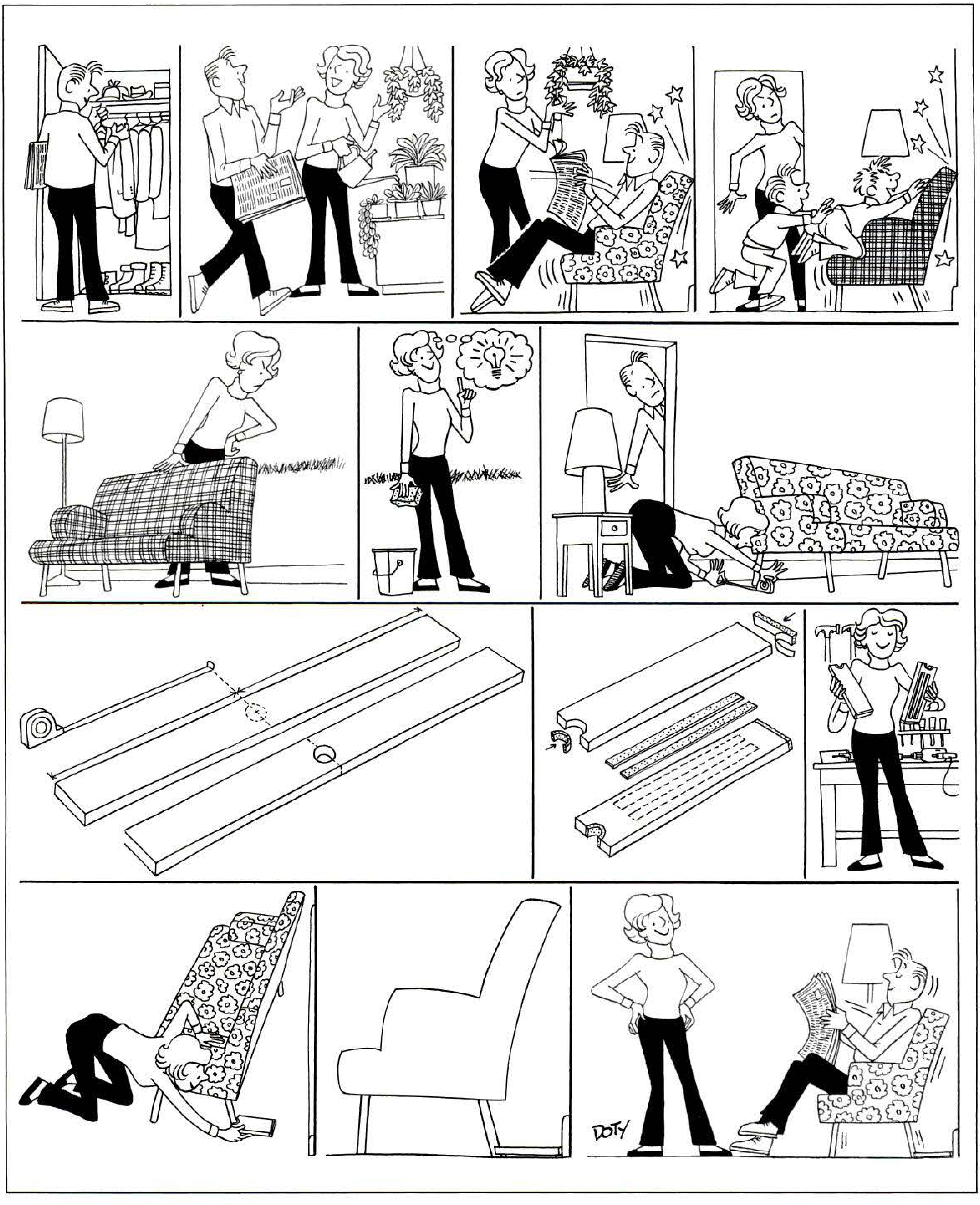

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Dressed for business—Apple's Mac Plus

New hardware and internal software make the new Macintosh Plus easier and faster to use. It's made for business applications, but personal Mac owners will want one, too.

Macintosh Plus

By JIM SCHEFTER

CUPERTINO, CALIF.

With the flick of a switch, Apple Computer's new Macintosh Plus hummed to life, taking only a few seconds to start directly from its optional 20-megabyte hard disk. I shifted the mouse under my right hand to bring the on-screen pointer to the hard-disk icon, clicked the mouse button twice, and entered the faster and smarter world of desk-top computing.

Introduced just two years after the bare-bones 128-kilobyte (128K) Macintosh, the Mac Plus is aimed at increasing Apple's share of the business marketplace. But this new high-octane model is also sure to get the attention of that growing army of individual Macrophiles out there. Among Mac Plus's features:

- A full megabyte of random-access memory (RAM), expandable to four megabytes.
- A double-sided disk drive that stores 800,000 characters of data on a 3.5-inch hard-cased disk.
- An SCSI (small computer systems interface) connection for attaching sophisticated peripherals like high-speed tape drives with data-transfer rates up to 320,000 bytes per second.
- An upgraded operating system.

The modified operating system for Mac Plus is contained in 128K of read-only memory (ROM), leaving the full RAM available to software and data. The operating system is faster; I found it is much better at managing files, particularly during the word-processing program I tried.

The Macintosh file system uses three kinds of icons—for disks, file folders, and data. In the old system, documents were stored only on the Mac desk top and had to be put into file folders after leaving the word-processing program. To look at one, it was necessary to activate a disk or file folder to see documents inside. Not anymore. To store a file using the new system, I used the mouse to point to the hard-disk icon. Instantly, I saw a list of file folders—each with the appropriate folder name—and I had my choice of which one to use. I could look at a file just as easily: A single click of the mouse reveals the contents of a disk or file folder without going through the process of getting access to it.

Mac Plus lets users set aside up to 768K of RAM, called a RAM cache, for direct use by programs. In theory this will decrease the time it takes to load and run a program. To try it, I activated the cache by selecting it from the Mac's Control Panel (a desk-top accessory that's available to all programs) with the mouse. Result: With the cache activated, Mac Plus loaded the MacPaint program in seven seconds, instead of the normal 14 it takes to retrieve it from the hard disk. According to an Apple spokesman, complex programs, depending on how they are written and how much memory they require, load about 10 percent faster than usual.

The megabyte or more of RAM opens the way for even more-complex programs than now available in such areas as desk-top publishing and integrated business applications. In one demonstration, I watched an Apple technician modify Lotus 1-2-3 data on an MS-DOS computer, then retrieve it on a Mac Plus and create a chart using Excel. It all took less than two minutes.

Apple's list price for the Mac Plus is $2,599. The company has also announced various kits to upgrade existing Macs to the new standards. PS

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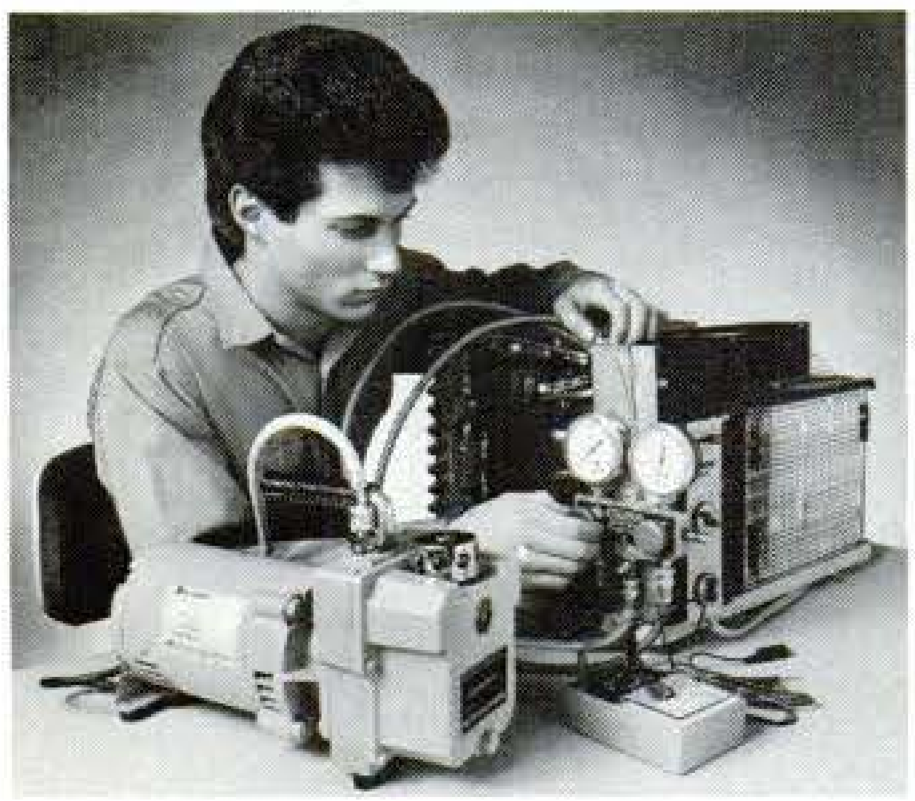

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Scramjets

[Continued from page 97]

accurate calculation of high-speed airflow turbulence. "Turbulence models are the big question," Mackley told me. "Our solutions are only as good as our input."

"Our computational people are trying out various models to see which ones work the best," states Lewis's Coltrin. "The problem is, the programs aren't user-friendly. You need the guys who wrote them or who have been running them for ten years. It takes a real expert to adapt a program to the next situation."

This means that as the scramjet program advances, flight tests will become significant. "We'd like to build an engine that would actually be flight-size," declares DARPA's Williams. This would be a scramjet module, up to 30 inches across and six to eight feet long. A number of these modules would be mounted side by side, across the rear underbelly of the aircraft. Williams would like to see two or more engine-building companies create such modules, then let their designs compete. Such scramjets would be extensively ground-tested, then qualified for flight.

New technologies needed

Developing advanced jet engines also means emphasis on related technologies. Researchers are considering using hydrogen as a coolant, for example, as well as for a fuel. Liquid hydrogen can cool the hot parts of an engine or airframe; in doing so it flashes into vapor, ready to be injected into a combustor. The hydrogen's heat then boosts the engine's power.

When the Orient Express is cruising, aerodynamic drag will heat its surface; but by cooling the craft with hydrogen, it will be possible to recover part of the energy lost to drag. And in the air turbo-ramjet, this hot hydrogen can spin the turbine that drives the compressor. The hydrogen will then mix with the airflow from the compressor, and burn to give the engine's thrust.

Another key set of technologies concerns materials. "You want materials that will not oxidize and burn up at very high temperatures," says Williams. "You also want high strength at low temperatures, as when the airplane is climbing out and is heavy with fuel." Thus, Williams sees two different types of materials as key to the aerospaceplane.

For high strength, light weight, and good temperature resistance, Williams looks to a DARPA program called Rapid Solidification Research. This program has produced metallic powders that look like flour but are gray in color—and dense. These powders

Continued

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We believe this amazing system is the best rust insurance you can buy! The principle of impressed current rust protection is not new. It has been used for years to protect underground pipelines, ocean going vessels, reinforcement bars on bridges, water towers, all kinds of high-cost equipment in the shipping, petroleum and construction industries. **One of our largest fleet users is involved in the mining and harvesting of salt compounds in Utah...They are doubling the life-span of their equipment! RustEvader users write us unsolicited letters praising its performance.**

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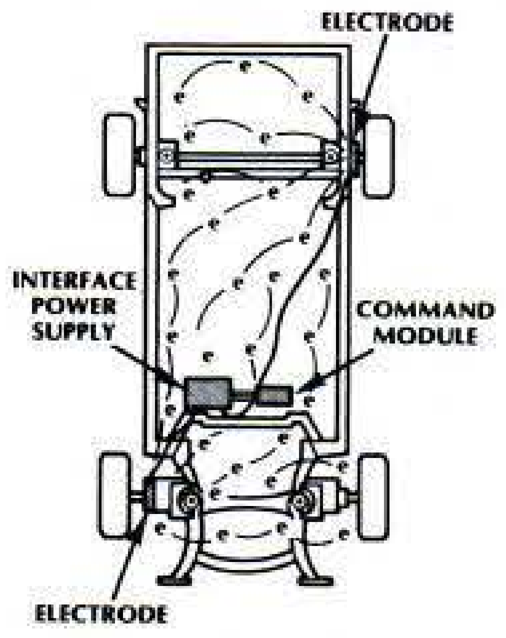

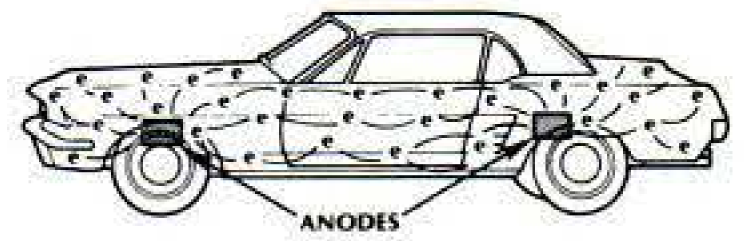

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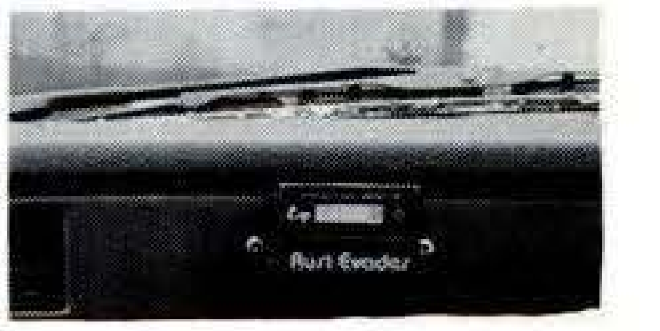

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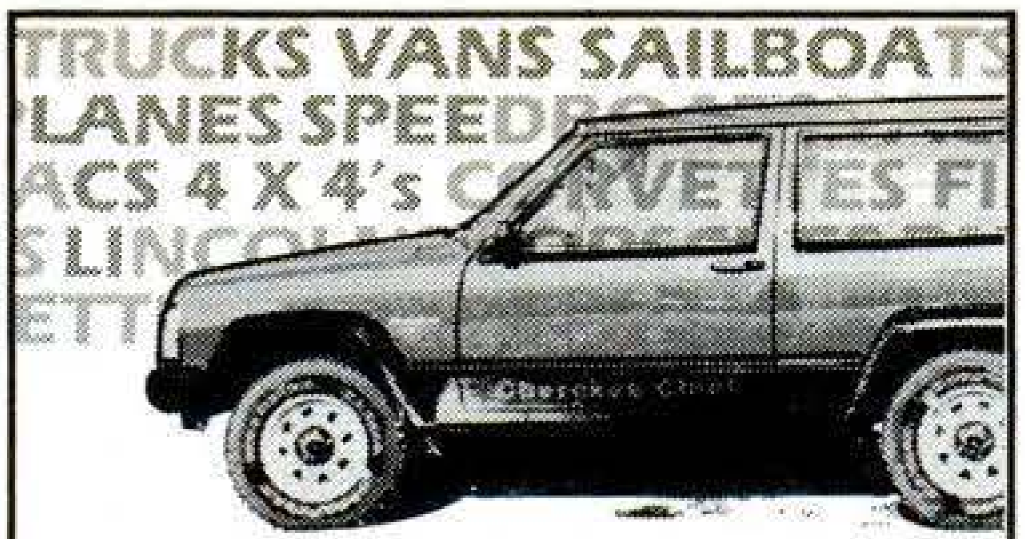

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Scramjets

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"You can freeze-in their properties," says Williams. "These materials are reaching a fairly mature state." Department of Defense contractors have shown that these powders can be heated and pressed to form structural parts for aircraft, with good strength and only half the weight of parts made from aluminum.

Heat begets strength

There is also a need for lightweight materials for the hottest parts of engines, wings, and fuselages. The key approach here is advanced carbon-carbon composites. Start with cloth made of rayon fiber, and bake it until it carbonizes. Impregnate such carbon fabrics with carbon dust—soot, if you will. Pile up a number of such fabrics amid more carbon dust; press them together; then heat them strongly. The dust and fabric will sinter together, yielding carbon fibers in a carbon matrix: a carbon-carbon composite.

"These materials are making a tremendous advance," Williams goes on. "You see, carbon has a very interesting property. It gets stronger the hotter it gets—unlike any other material—up to the point where you oxidize it. Then you create carbon dioxide—at which point your whole structure vaporizes and goes away. As long as you can prevent it from oxidizing, by using suitable coatings, you get the increasing strength."

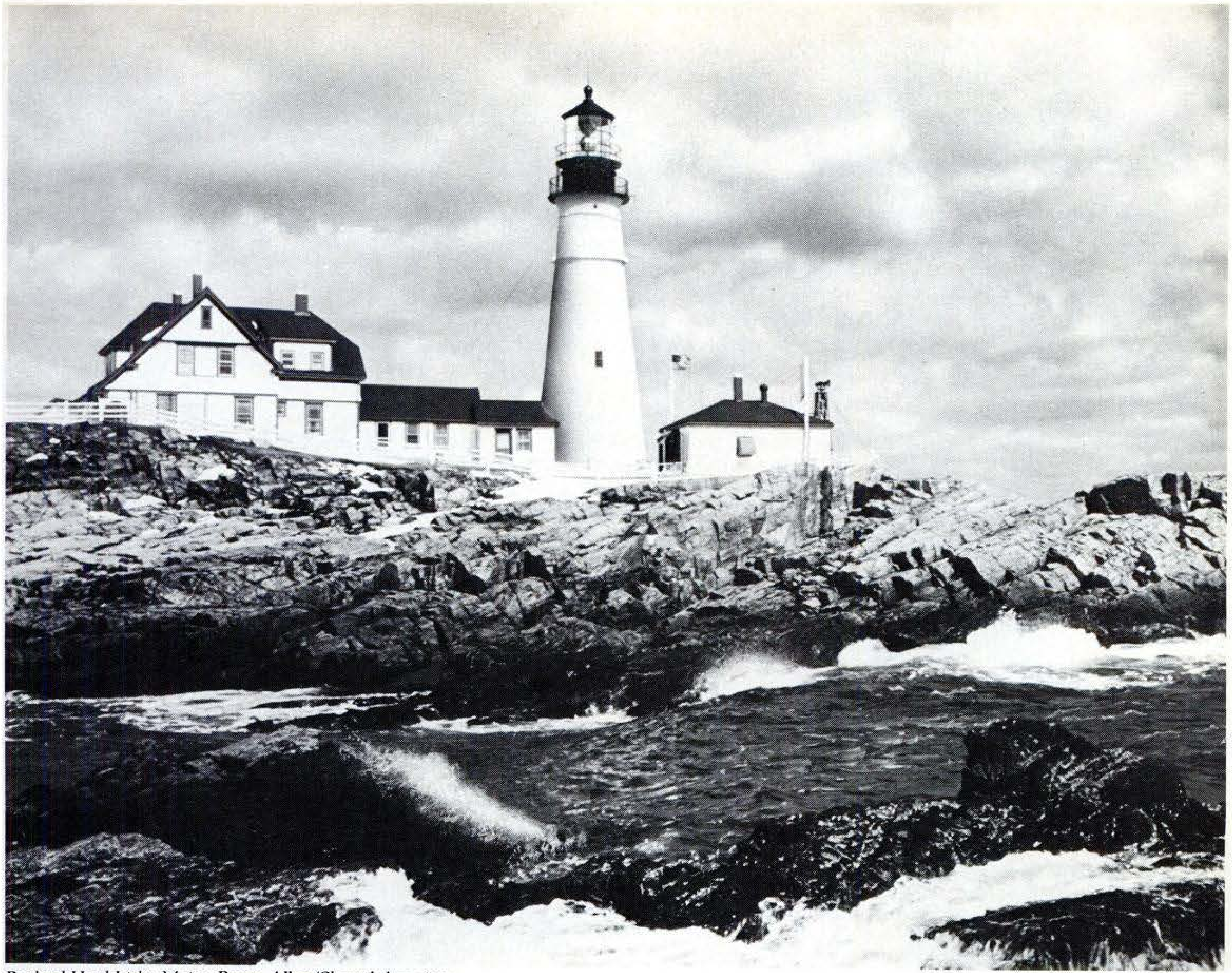
Williams points to a Viewgraph showing an air-turbo-ramjet turbine made of carbon-carbon. It's nearly 15 inches across; it has 36 blades; and it had been tested at 40,000 rpm. It weighs a mere 7.5 pounds.

"It appeals to the soul of an aerodynamicist," Williams muses, "to try to compete with the rocket boys at their own game. What you do with a rocket, you do by brute force. You don't devise ways to get oxygen out of the atmosphere, even though it's there for the taking. Instead, you liquefy the gas and carry it in a tank.

"You do not rely on subtle aerodynamic processes within the engine. Instead, you rely on turbopumps, which are the most God-awful things to design and develop.

"And you don't use wings to fly; instead, you physically push the rocket up by thrusting against its dead weight.

"Compared with the rocket, the scramjet is a very elegant technical approach and a very elegant, enormously efficient aerodynamic device. It is an engineer's delight." PS



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Camcorder showdown

[Continued from page 111]

Huber, vice president of marketing for Zenith Electronics Corp.'s consumer-electronics division. "We found that people who buy camcorders already own a VCR, and eighty percent of those VCRs use the VHS format."

VHS camcorder makers stress that picture quality and compatibility between VCRs are most important. "It goes beyond your own home machine," says Huber. "Just try swapping an eight-millimeter tape with a friend or renting an eight-millimeter movie."

Because of the larger tape, VHS machines have built-in high-quality picture reproduction. "Our problem," says George Hrbek, director of video operations and engineering for Zenith, "was maintaining the home VHS format for picture performance while at the same time reducing the head drum for smaller size and less weight."

VHS camcorders use a head drum that's nearly half the size of the drum used in standard VHS recorders. To maintain compatibility, the drum contains four heads (two more than standard VHS), spins at higher speed (2,700 rpm versus 1,800), and has a 270-degree threading angle as opposed to the standard 180 degrees. "Although the drum is smaller, the writing speed is identical to standard VHS," says Hrbek. "It's totally compatible."

The smaller, lighter drum design has had a snowball effect, cutting pounds and inches off the new camcorders. "All the associated deck components become smaller and lighter," says Hrbek. That cuts weight, of course, but it also means that they don't need excessive support either. Result: Even the weight of the all-steel transport base required on earlier models has been shed. "The new models use aluminum," Hrbek says.

Although new VHS camcorders like the Zenith 7000 and RCA ProWonder I tried are still heavier and larger than 8-mm units, I found that the small difference meant little: They are comfortable and easy to use. And, of course, picture quality is excellent.

Tough choice

So how do you choose? "If you don't own a home system and all you want to do is make movies," suggests Bob Ridell of GE, maker of both VHS and 8-mm format camcorders, "the smaller eight-millimeter camcorder is for you. But if you have a home VCR, compatibility is extremely important, and you should choose VHS."

And for the millions of people still on the fence about home video? Ridell sides with VHS: "The tapes are cheaper, and prerecorded tapes are available."

Of course, in time, those reasons can change with the acceptance of 8-mm machines. (Paramount will release the first 8-mm prerecorded movie shortly.) And adds Ridell: "Basically, there is no significant difference between VHS and eight-millimeter. The picture quality from both types exceeds the capability of a typical TV, so you won't see any difference. And the sizes [of the machines] are coming close enough together so you won't feel any difference."

Translation: If the battle between VHS and 8-mm camcorders has just begun, it will be a long war. PS

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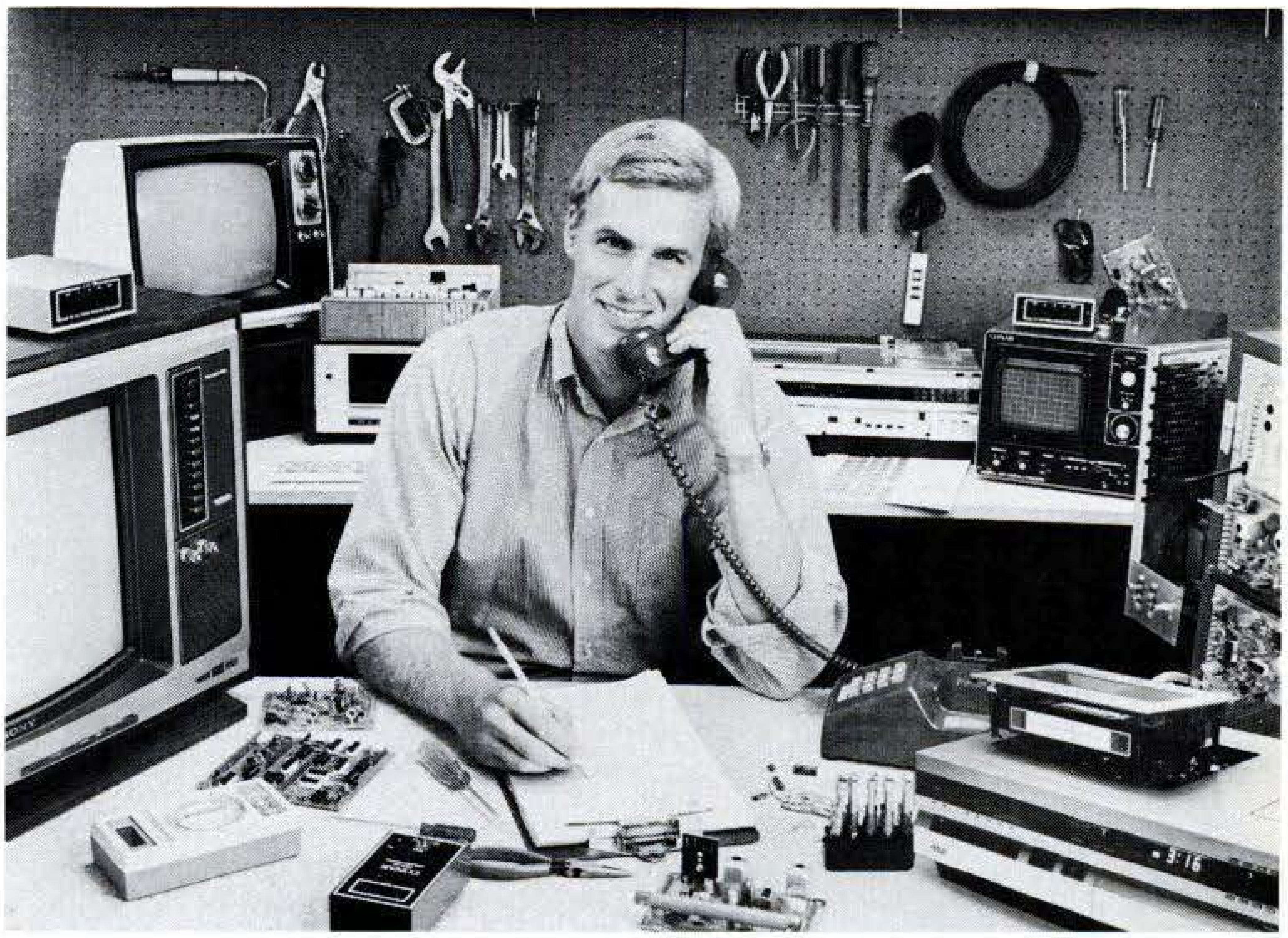

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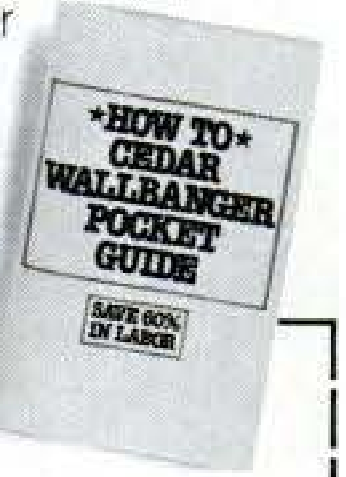

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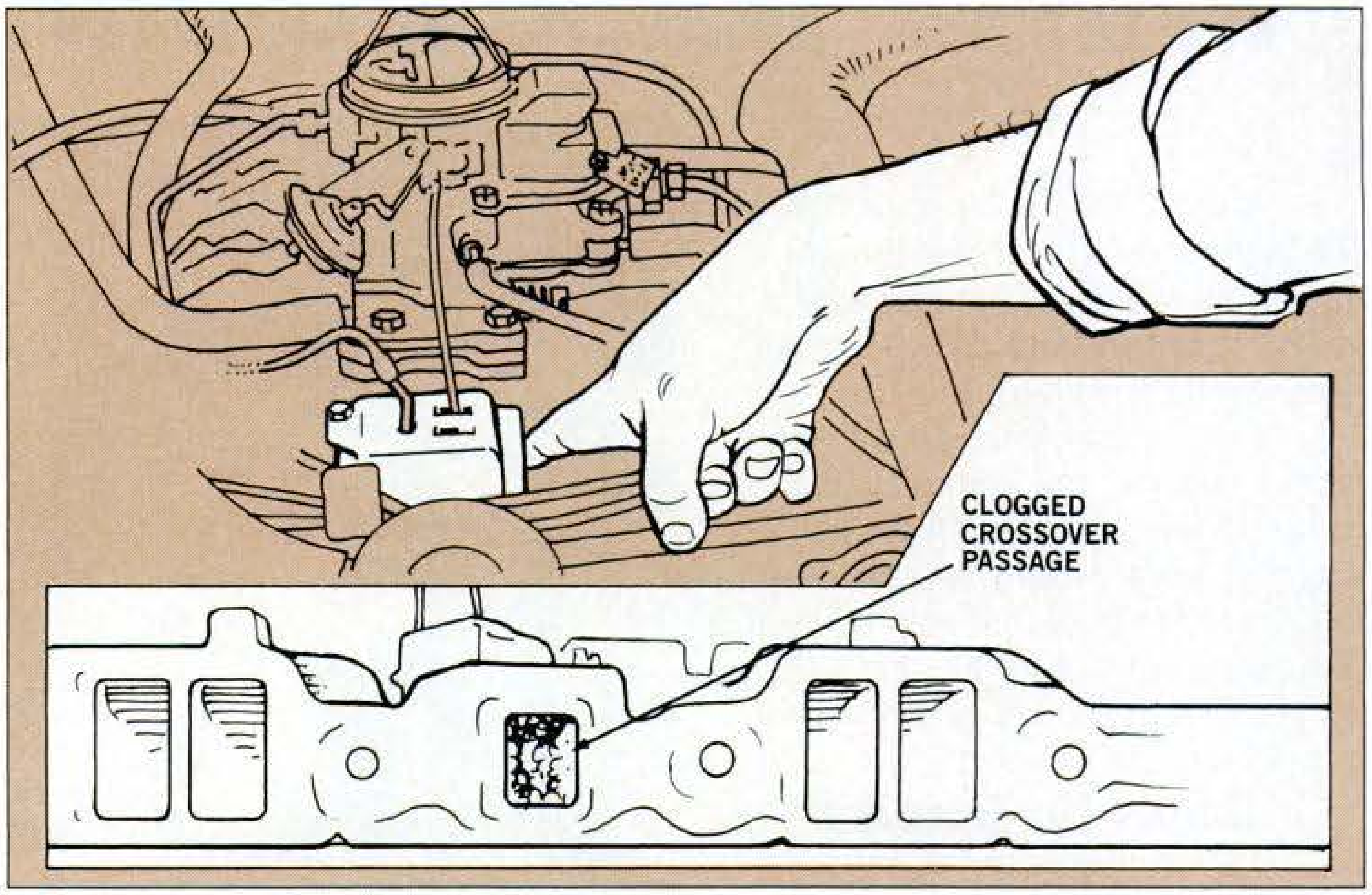
Taking Care of Your Car

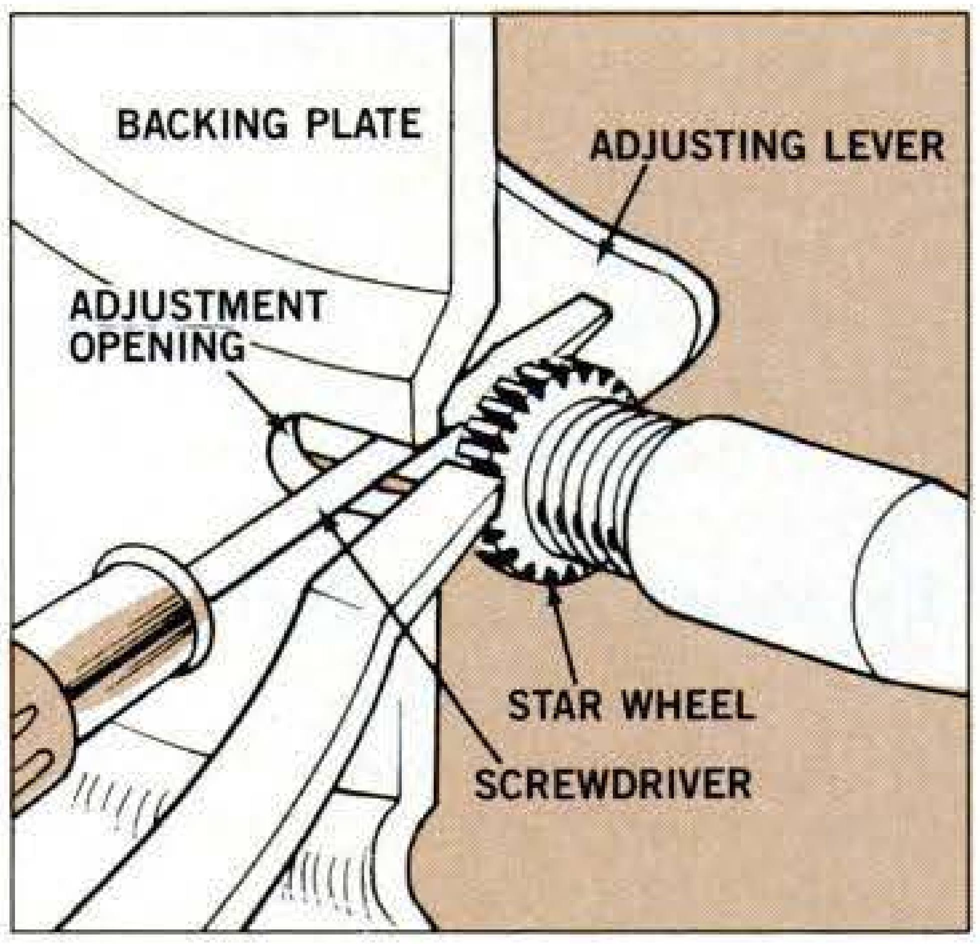
By STEVE MERCALDO

Got a useful car tip? Send it (with Social Security No.) to Car Care, Popular Science, 380 Madison Ave., New York, N.Y. 10017. We'll pay $50 if we use it. If two or more readers send the same tip, payment goes to the one with earliest postmark. No tips can be returned.



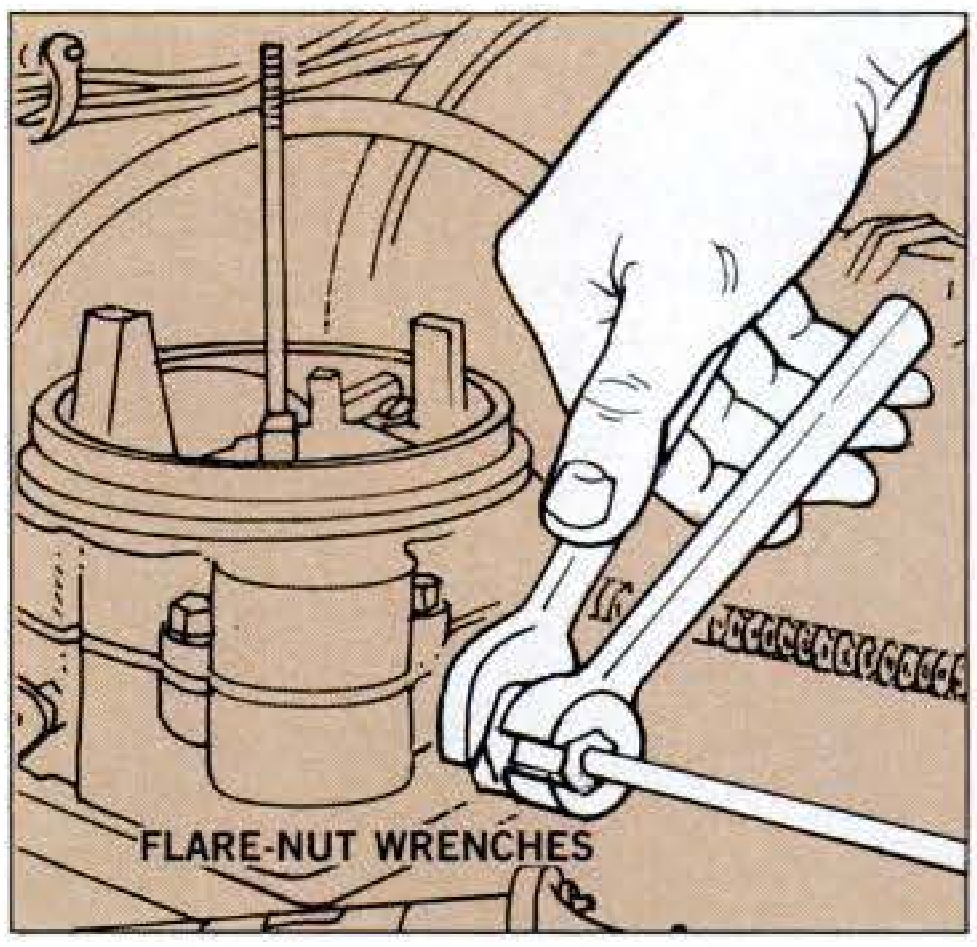
Plugged manifold

Hesitation and poor fuel economy are two symptoms of a plugged or malfunctioning intake-manifold exhaust-crossover passage. The exhaust heat aids fuel vaporization for smooth operation during start-up and cold weather. First, check the exhaust-manifold heat-riser operation. Is the riser OK? Check for blockage. Start the engine *cold*, and let it idle for several minutes. Carefully touch the manifold's crossover area with your fingertips. If it's just warm or cool, the passage is plugged. Caution: If it's functioning properly, the exhaust-crossover area will be extremely hot.



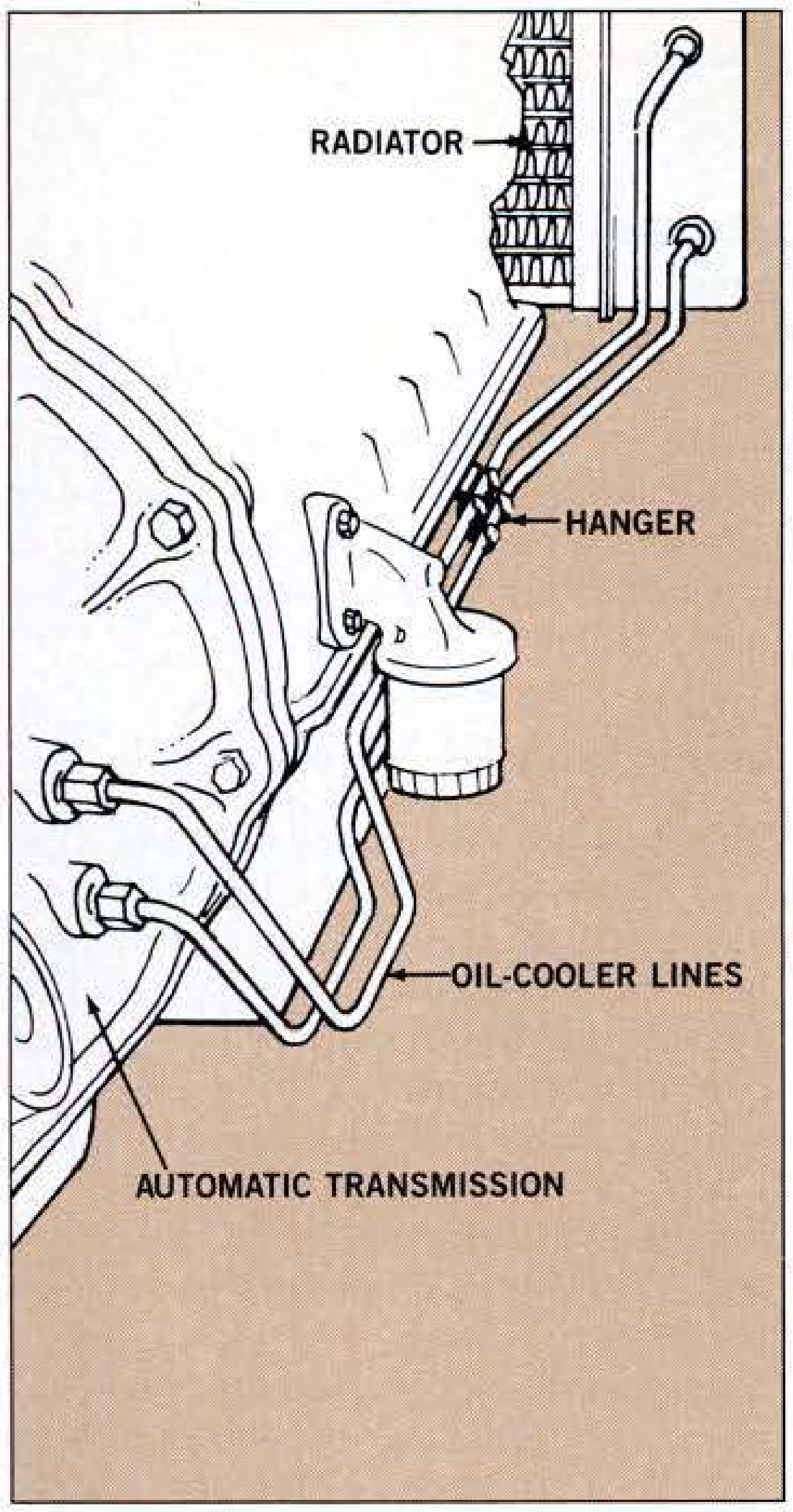
Stubborn drums

Brake drums that refuse to come off are frequently being held in place by their shoes. On self-adjusting brakes, a wear ridge often forms in the drum, and the shoes settle into this ridge. The solution is to back off the brake adjuster wheel until the shoes lift out of the ridge. The brake drum can then be easily removed.



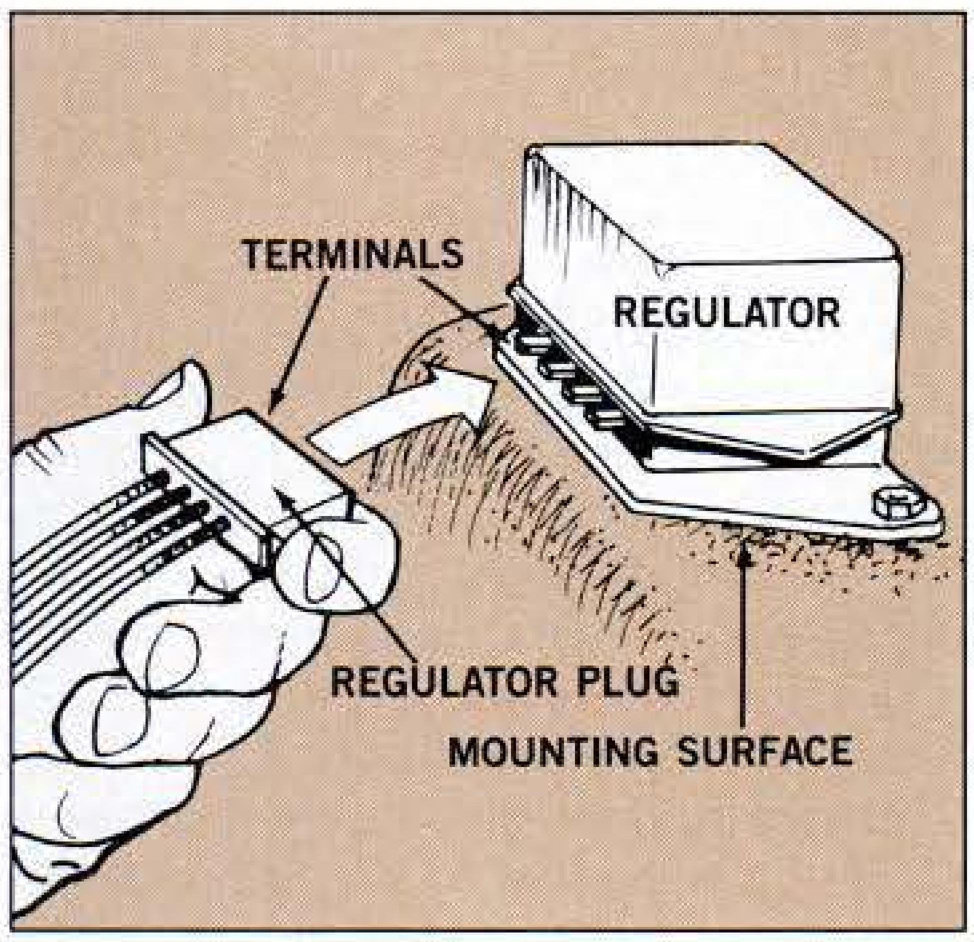
Squeeze play

When you use two hands and two wrenches to turn it, the carburetor fuel-inlet nut often loosens abruptly. This usually results in your getting a bruised knuckle. To prevent this, position the wrenches in one hand so that a squeeze will loosen the line without disturbing the bowl fitting. Reverse the wrenches to tighten it.



Transmission tip

Periodically inspect automatic-transmission cooler lines for signs of abrasion or damage. Spotting a worn or crimped section of tubing before it ruptures can prevent transmission-oil loss and possibly an overhaul. Prevent future damage by supporting lines with a rigid clamp or hanger.



Regulator checkup

Small but important to your car's charging system, the voltage regulator can cause an intermittent-charge or no-charge condition. If an instrument-panel gauge indicates a problem or your battery goes dead, clean and inspect the regulator's connections and ground before replacing the alternator, battery, or regulator.

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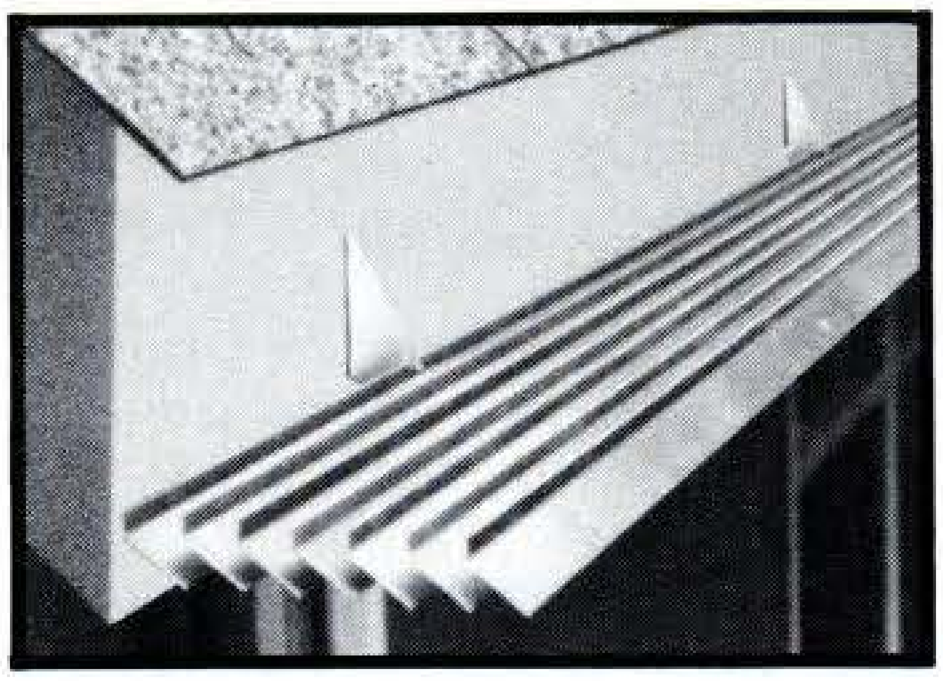

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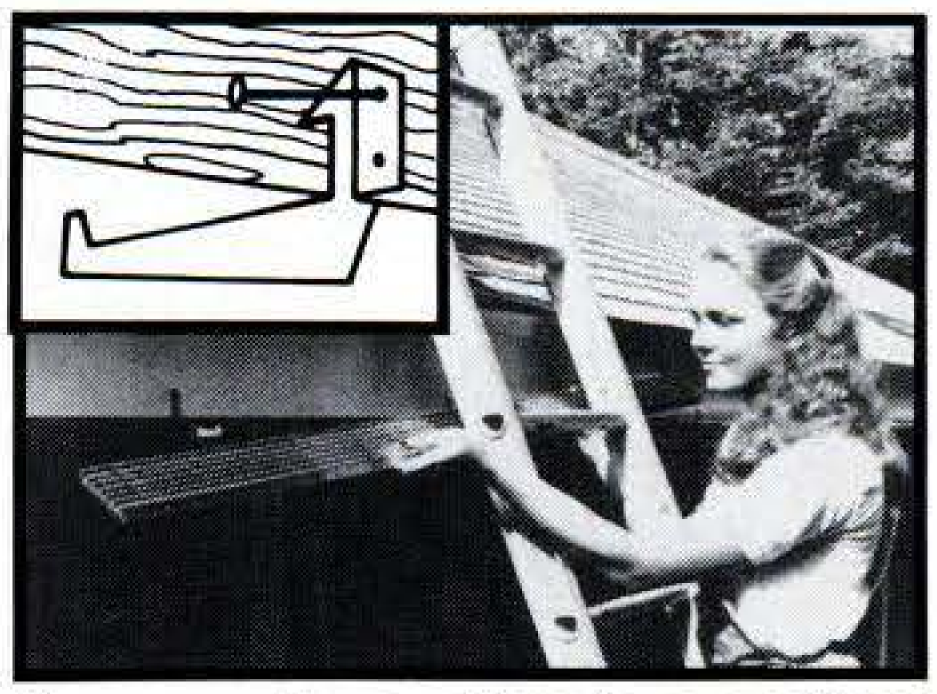

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Rotten eggs

After 200 miles my 1985 Honda Accord LX started emitting a rotten-egg odor so strong that the car couldn't be stored in the garage, which is located under the house. Different brands and octanes of gasoline don't help. What do these powerful odors indicate?

R. Rusato, Frederick, Md.

Three-way exhaust catalysts like the one on your Honda can become pretty bad-smelling as they're getting up to operating temperature. The air-fuel mixture could also be rich—too much choke, for instance. Make sure your mechanic uses the propane method when setting idle mixture; hydrocarbon and carbon monoxide analysis can be misleading because the converter is working upstream of the exhaust pipe. Unfortunately, just about all three-way converters stink.

Shaky brake boost

My 1983 Honda Accord occasionally loses its power brakes. The power boost fails just after start-up while I'm jockeying to pull into the street. Stopping the engine and restarting it always cures the problem. What's wrong?

Will Birkner, San Diego, Calif.

A good place to look for the trouble is the vacuum check valve in the brake-booster supply line—it's probably sticking.

Exhaust exasperation

Why can't new cars be purchased with stainless-steel exhaust-pipe and muffler components as an option? I've spent untold hundreds of dollars and hours on exhaust systems in the last 20 years. Now my 1982 Ford Escort needs an exhaust pipe at 28,000 miles, although the muffler is fine. It will cost $105 to replace the pipe, and you can't just buy the pipe alone. Clever!

Fred Mathews, Beloit, Wis.

More and more car models are appearing with stainless-steel exhaust systems, including headers, every year. I'm seeing lots of stainless-steel exhaust parts on General Motors vehicles. I agree that an all-welded system is hell when one part goes prematurely. The one advantage to this design is that it won't leak.

Overcharged battery

The battery overcharges in my 1980 O24 Dodge Omni. The alternator, voltage regulator, and battery all have been replaced twice. The battery still overcharges to the point where its caps pop off overnight.

Warren Gill, Brandon, Miss.

I suspect a wiring error. For some reason, the alternator doesn't know what the battery voltage is. Take the car to an automotive electrician and have him check the input voltage to the voltage regulator. It sounds like the voltage regulator might be wired out of the loop, so there's no control on the alternator's output to the battery.

Why engines knock

I keep hearing people complain about spark knock. When I was a young mechanic in the 1920s, we used to get 50 cents per cylinder for burning the carbon out of engines. Why isn't this done today?

Pat McVicker
Daytona Beach, Fla.

In the old days, carbon was the problem. Today, 98 percent of the time it's something else. New engines run hotter, using leaner fuel-to-air mixtures burned at higher compression ratios. They also burn fuel without added lead. All of these conditions can encourage detonation. Unfortunately, under optimum conditions for best fuel economy and emissions, combustion is difficult to control. Detonation is the result.

Bashed bushings

In 20,000 miles I've gone through three sets of upper front-suspension strut bushings on my 1983 Dodge 600ES, and now I need a fourth set. I cannot believe how weak the front end is. I like this car, but I can't afford to keep it.

Robert E. Grahn, Poseyville, Ind.

I checked with the factory, and they tell me the bushings haven't surfaced as a major problem. I wonder whether the front end is improperly assembled, causing the struts to carry loads incorrectly. Chrysler Technical Service Bulletin 02-04-85 describes the correct procedure for diagnosing strut mount conditions. Bulletin 02-01-83 refers to installing front strut upper seats and dampers. Maybe one of these will give you the answer.

Rattle and roll

My 1981 Dodge Aries has a rattling noise that comes from the right front side of the engine compartment. The noise occurs from 15 to 35 mph on rough surfaces. The Chrysler dealer thought it might be a transaxle problem and offered to take it apart and explore for $350, but he wouldn't guarantee a solution. The noise is steadily increasing from month to month. I'm almost ready to let the dealer take a second look.

Lynn Venteicher
Pella, Iowa

The noise you describe sounds like it could be caused by strut-bushing ferrule movement or loose sway-bar link ferrules. Have the dealer refer to Chrysler Technical Service Bulletin 02-06-81.

Crooked path

My 1985 Nissan Maxima GL pulls to the left on acceleration. The dealer has checked the alignment on all four wheels and tried installing another set of tires. New motor mounts were also installed. Nothing helps.

Sam Antonio, Elmont, N.Y.

Front-wheel-drive cars with low-profile tires are especially sensitive to a tire that is slightly conical—that is, a tire with one shoulder slightly smaller in diameter than the other. I've heard that this problem is fairly common on Maximas. Your best bet would be to swap front tires with a Maxima that doesn't have the problem. See if that cures the pull. If that's not practical, try switching your left and right front tires and see if the pull changes. Otherwise, look for something loose in the front suspension or drive train that might allow movement when torque is applied.

Got a car problem? Send it to "Say, Smokey—," POPULAR SCIENCE, 380 Madison Ave., New York, N.Y. 10017. All letters are read, and those of widest interest are answered in this column. Due to the large volume of mail, Smokey cannot reply to letters not selected for publication.

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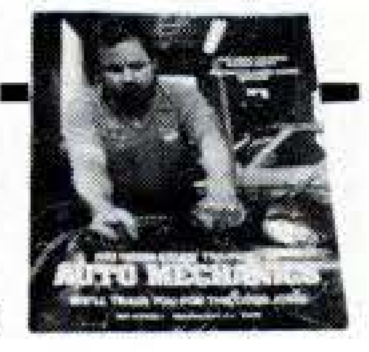

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Never-ending hot water

[*Continued from page 108*]

cording to the engineers' figures. That includes 56 cents for boosting the water temperature plus the daily standby heat loss of 62 cents. That second number comes from multiplying the daily standby loss at six percent per hour by the value of the heat stored in the tank (43 cents).

On the other hand, Thermar's Homemaster Deluxe, a gas-fired tankless unit, has no standby losses or a tank to hold heat. The 53-cent daily operating cost is reportedly more efficient than using a conventional heater to supply the average family's hot water.

For electric heaters, the yearly cost is $549 for 50-gallon storage units and $339 for tankless models, say Thermar's engineers. Here's how they break down the daily cost: With electricity at eight cents per kilowatt-hour, and a three-percent hourly standby loss, the storage tank costs $1.45 to run. Two small tankless heaters in series can reportedly supply 64.3 gallons of hot water for 93 cents.

A tankless heater can also save your pipes. Water can be a nasty thing: Kept above 120 degrees in a storage tank, the water's alkali calcium will corrode the pipes and tank. The higher the temperature, the more severe the corrosion. Unchecked, calcification can shut down a water heater and lead to costly re-piping jobs.

To enjoy the economical benefits of a tankless heater, you may have to change water-use habits. Unlimited hot water is available—all you have to do is a little planning. "You can't take a shower and run the dishwasher simultaneously," says NBS's Harris. "One appliance at a time may be the rule, although you may be able to shower and run the faucet."

If that's too drastic a change, consider installing a tankless heater as a point-of-use booster. Keep the storage tank, but turn the thermostat down to 110 degrees. This will save energy, cut standby loss, and help avoid pipe corrosion. Then add a booster as close as possible to the dishwasher to push the temperature up to the necessary 140 degrees.

Endless hot shower

The quintessential point-of-use heater is the unique self-heating electric shower head from Pecbras that connects to the cold-water line. "You don't even need a hot-water heater—tankless or storage—to use this shower head," says Erwin Frey, president of Pecbras.

The two-pound UL-listed unit replaces your shower head. On first blush, you might think that electricity and water don't mix—and you're right. Installed properly, they won't. The heavy-duty electrical cord is pushed through the shower wall, under the shower head. Inside the wall, it hooks to a waterproof junction box.

How steamy will an endless shower be? "At one-and-a-half gallons per minute, the water temperature is between a hundred ten and a hundred twenty degrees," says Frey. "At two gallons per minute, it's about ninety-five degrees." According to Frey, the low-flow shower is quite pleasurable. "In many water-saving heads, there are holes only around the circumference. In our unit, there are fifty-two holes eight-tenths of a millimeter wide all over the head."

Savings with a booster-and-storage-tank combination can add up. "A booster heater can give a thirty-three percent saving in hot-water heating bills," says Lynn Jardinico of Chronomite. "We estimate that in ten years, a homeowner can save $3,500. That represents a forty-percent saving on energy costs and sixty percent on the projected cost of replacing a storage tank and pipes."

Finally, there's one use of a tankless heater that isn't concerned with energy savings: as a stand-in for sunshine in solar-heated hot-water systems.

On some days sunshine isn't abundant enough to heat the water in a collector tank. When that happens, a modulating tankless heater can boost the water from a solar tank to a preset temperature.

There's only one complication: A modulating unit always provides some heat when activated. "Our unit can modulate down from 77,000 to 22,000 Btus per hour," says Controlled Energy's Pierre Moffroid. "But it always fires at least 22,000 Btus." So water that's already 140 degrees will be heated again. Although many units will automatically shut down when the water temperature exceeds 180 degrees, bypass and mixing valves are needed for protection against slightly lower but still scalding temperatures.

You can avoid the plumbing chore of installing those valves if you're willing to forgo temperature control. Aquavac, a fixed-output heater, features a unique gas-control valve that shuts off the burners when the incoming water hits 140 degrees. There is no minimum firing level. Moffroid says he expects the American Gas Association to approve a similar valve soon. "With a zero-modulation valve, our heater will be able to turn the gas off if the water arrives at a hundred forty degrees," says Moffroid. "At a hundred thirty-five degrees, the unit will kick on, add five degrees, then shut off." He expects to have zero-modulating units on the market by early 1986. **PS**

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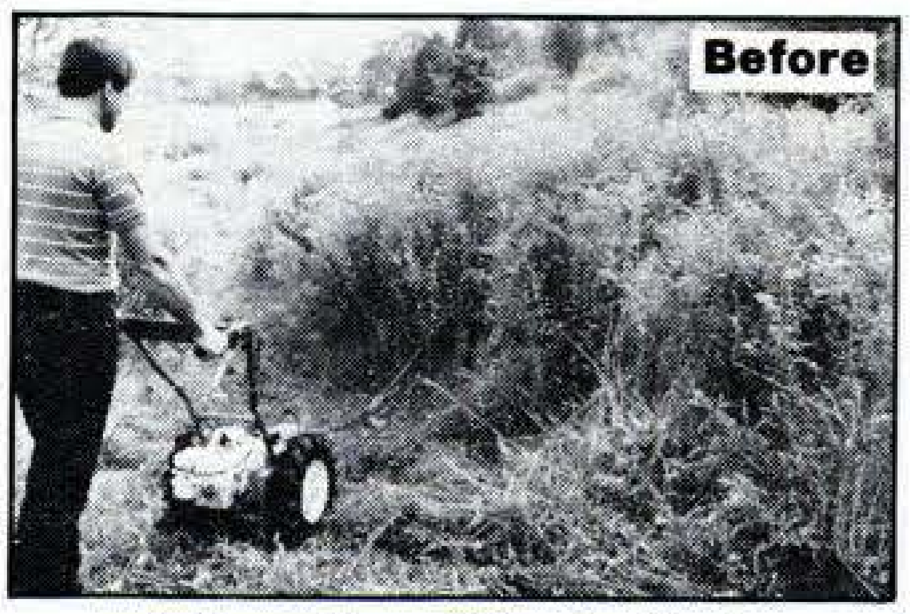

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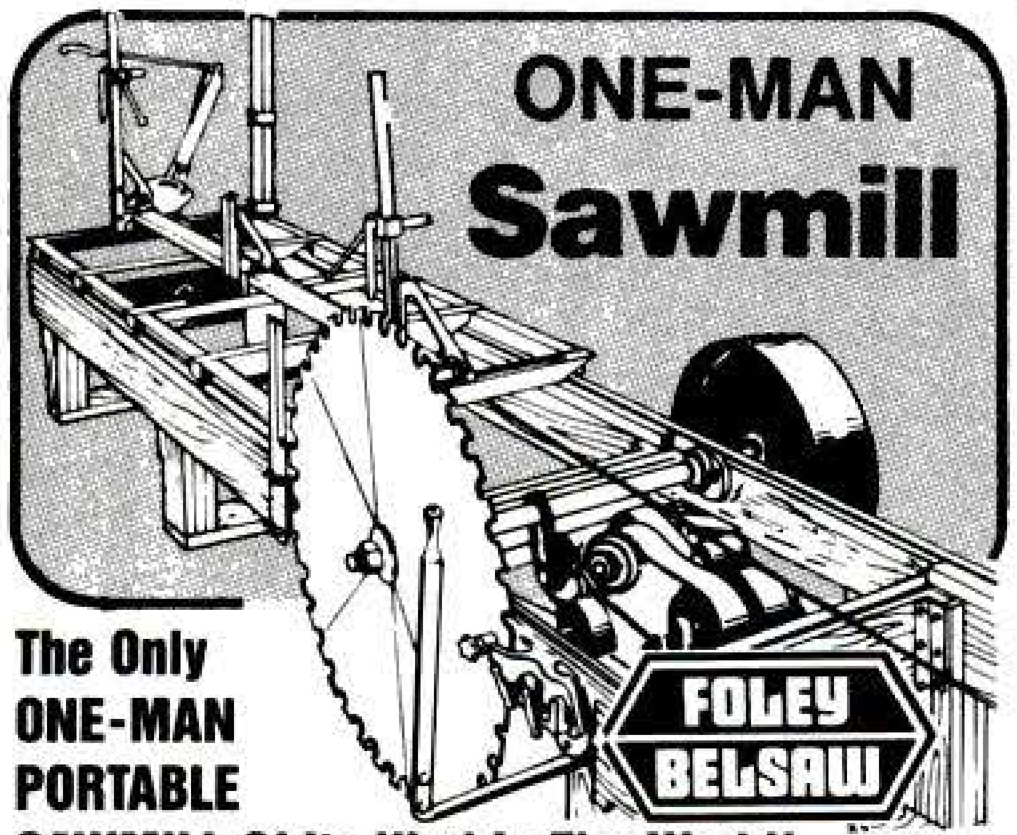

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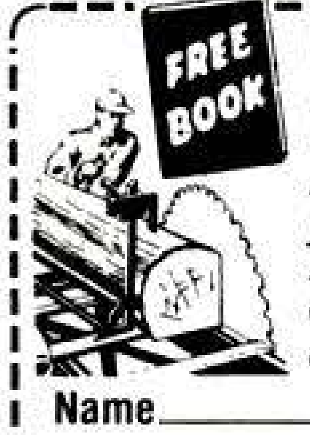

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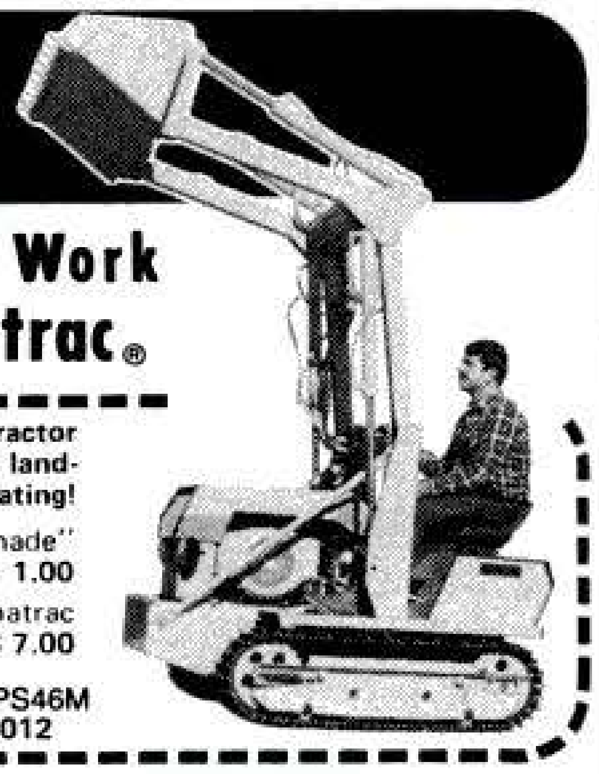

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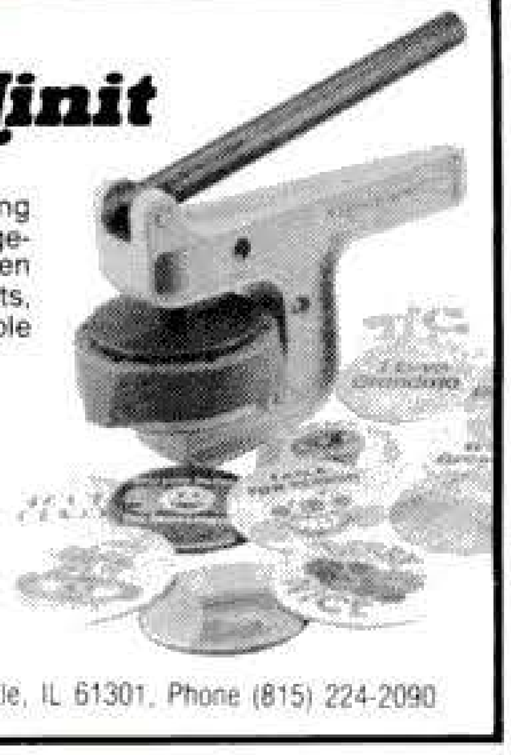

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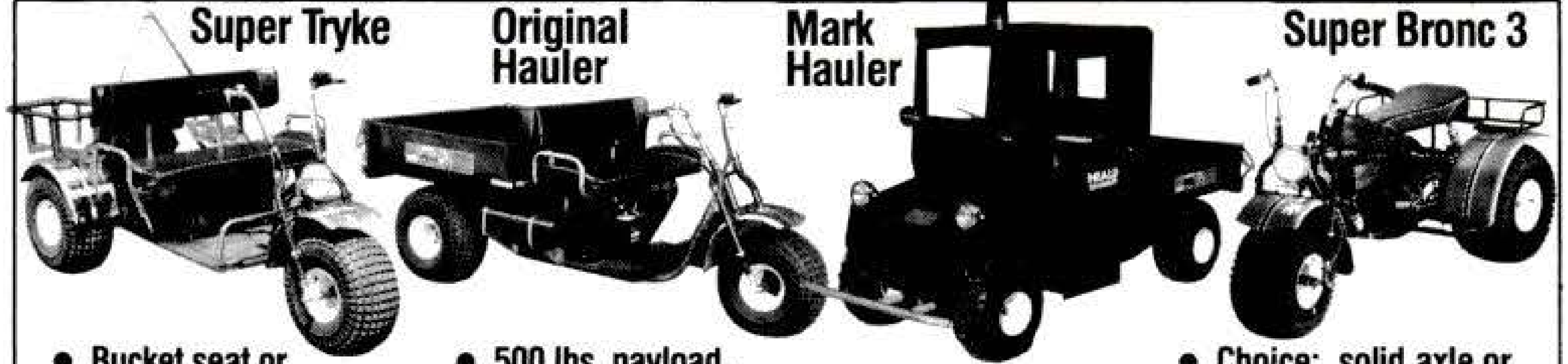
"My son (age 12) and I put it together in 12 hours!"

Mel Foltz, Sunrise Beach, MO



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QUIT YOUR JOB or START PART-TIME. Chimney Sweeps Are Urgently Needed Now!

My name is Tom Risch. I'm going to show you how to make $200.00 a day saving people from dangerous chimney fires.

This is serious business. People are paying $55.00 to have their chimneys cleaned, and the average sweep completes the job in less than an hour. You can make $200 a day part-time—$1,000 or more a week full-time. Now before you turn the page, let me explain.

Tens of millions of people are burning wood to supplement the high cost of oil, gas, and electric heat. There are now over 50 million woodburning chimneys in the U.S.—an increase of 10 million in only one year.

As a result, an estimated 44,000 chimney fires killed almost 1,000 people last year and destroyed over 180 million dollars in property.

Thousands of chimney sweeps are needed now.

Time Bomb In Your Chimney

A dirty chimney with about a quarter inch of soot contains a highly flammable substance called Creosote. If a spark from your fireplace or woodstove ignites the creosote in your chimney—watch out! The draft gets stronger and stronger, and before you know it, the entire inside of the chimney catches on fire.

As the fire grows in your chimney, the draft also increases to a tremendous velocity. The heat, generated from the draft and the burning creosote reaches a temperature of up to 3,000° F which is hot enough to melt the mortar holding the bricks together. Secondly, small flaming balls of creosote loosen from the side of the chimney and are projected out of the top with the force of a jet engine.

Like a roman candle, these flaming creosote balls shower the area. Some land on your roof, on your lawn and on your neighbor's home. The excessive heat of the chimney can catch the wood framing of your house on fire.

The only way to avoid a disaster like this is to clean the chimney before it catches fire. This is where you come in.

Chimney Sweeping

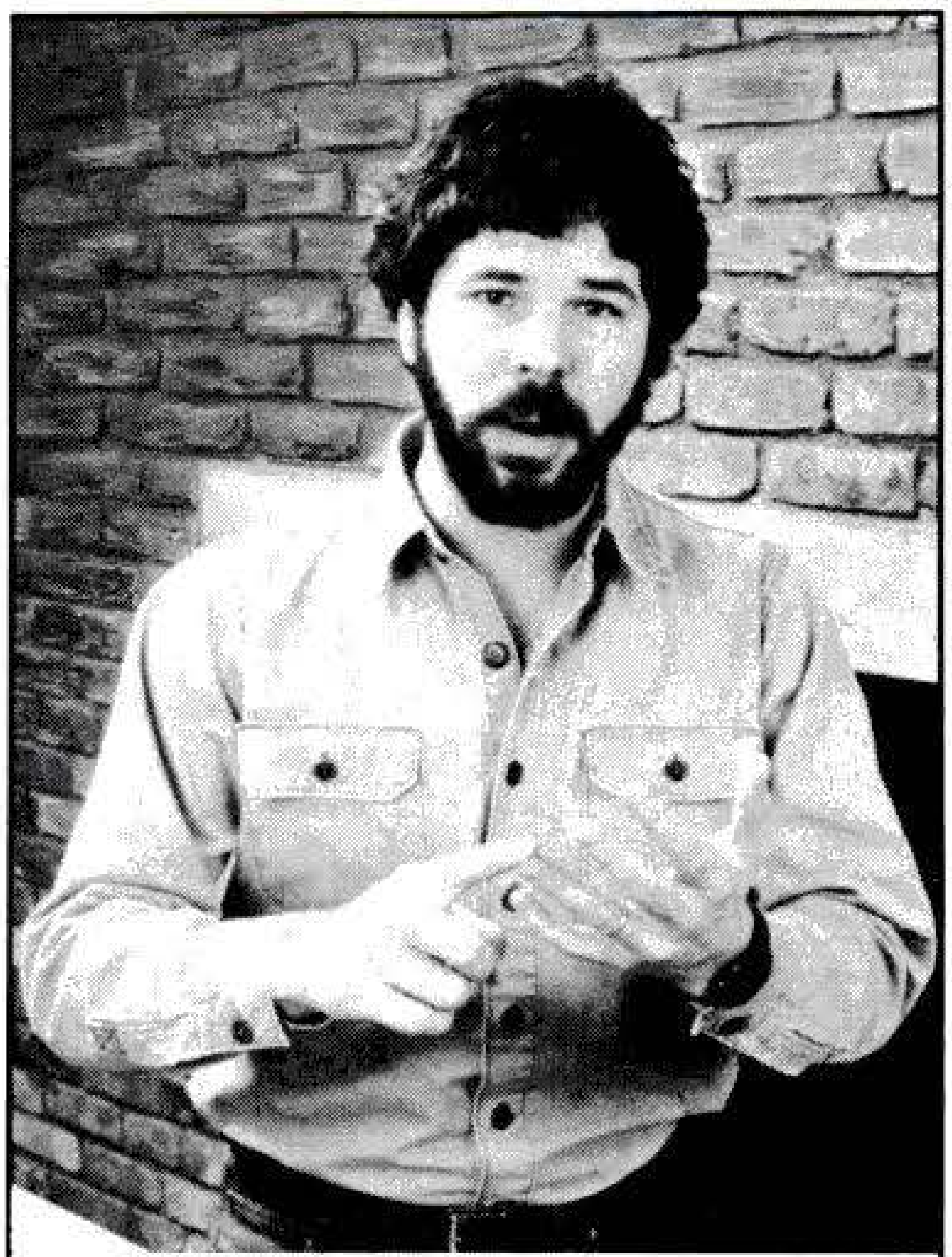
Here's a new business where you can earn more in one hour than most jobs pay for a whole day. More in one week than a lot of people make in an entire month. You're the boss. You set the hours and best of all, it's fun. You'll work your tail off, but the business will be your baby. I've had people tell me that the August West Chimney Cleaning System literally changed their lives. Not just because of the money they are making or the fact that they use more Ivory soap, but mainly because they are motivated. They're doing their own thing and loving it.

How Much Money?

Recently I telephoned some of the people we helped get started in the chimney cleaning business. I wanted to find out—first hand—just how well they were doing. Here's what a couple of them said....

Dave Richison, Ohio

"The 3rd quarter of this year I did $23,000. The 4th quarter I did $24,000. We should hit between 55 and 60 thousand this year."



"Home heating is now the number one cause of residential fires. Eighty-six percent of wood heat related fires originate in the chimney. The demand for qualified chimney sweeps is skyrocketing and now is the time to get started," says Tom Risch, Founder of August West Systems, Inc.

Chris Nestor, Massachusetts

"My first day on the job, I cleaned seven fireplaces. Now, after sweeping over 8,000 flues, I still look forward to going to 'work' every morning — six days a week, all year round."

John Moszulski, Canada

"Last month I worked 18 days, and I made 2,600 bucks!"

Ed & Mo Simonson, Texas

"We're very pleased with it. We're making a dream come true. We've always wanted some land, and thanks to chimney sweeping we now own 30 acres."

Just what do these people do to earn that kind of money? Sweep chimneys. Six to eight a day if they're full-time. Two to three an evening, plus ten or so on the weekends for those part-timers who keep their present jobs. Since the average charge is $45 for the first and $35 for each additional in the same house, it's easy to see how John Moszulski made $2,600.00 in 18 days!

The Height of Technology

How do you clean a chimney? You do it as quickly and efficiently as possible. The more chimneys you can clean in a day the more lives and loss of property you'll save. And how do you do a good job in record time? You use the most advanced system available—The August West System.

One of the key elements in the August West System is the SootSweeper. This machine is a high-powered, high-volume dust collection unit that was designed specifically for cleaning chimneys. New filter technology is the key to its efficiency and dependability.

Other key elements of our system are an assortment of high carbon steel brushes, specially designed fiberglass cleaning rods (that let you do most jobs from below), an easy-to-follow handbook with everything from advertising to chimney design, a bi-monthly newsletter, telephone consultation and much, much more. I don't have room to go into all the details right now. Our information kit will explain everything to you.

10 Years of Dependable Service

I'd just like to say that many years and a tremendous amount of devotion have gone into the development of the August West System. We are a strong, national company with thousands of dedicated sweeps in our network! You can join us and count on us to help you build a business you can be proud of. We take pride in the quality of our equipment and service to you.

Sweep John Moszulski says, "Not only do I think your System is fantastic, but I am also totally impressed by the way you treat people who have bought your System. I have just finished my third $1000 week—on a part-time basis."

To Sum Up, Then...

Sweeping chimneys may not exactly be a "Lazy man's way to riches"... you'll work hard—but the pay is exceptional, the demand is steadily growing, and new equipment and methods make the job far easier, faster and safer than ever before. Perhaps best of all, this is one of those "dream" businesses that so many of us are always looking for: a cash business with flexible hours, low overhead and a reasonable start up cost—figure about $1900 to get started.

And don't forget, when you run a small business out of your home, you can take tax deductions for that portion of your home you use for your office and work area, as well as car payments, phone bills, utilities and anything else you use in business.

As a matter of fact a lot of sweeps pay for their system in tax savings alone.

FREE Information Kit

Find out more about what it's like to be a chimney sweep cleaning 25 chimneys or more a week. Just call TOLL-FREE 800-225-4016 and ask for extension **457**. I'll rush you a detailed information kit with the complete August West Story and your 33⅓ RPM record entitled, "Now Hear It From The Sweeps." We urge you to call us at no obligation, TODAY.

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or write:
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August West Systems
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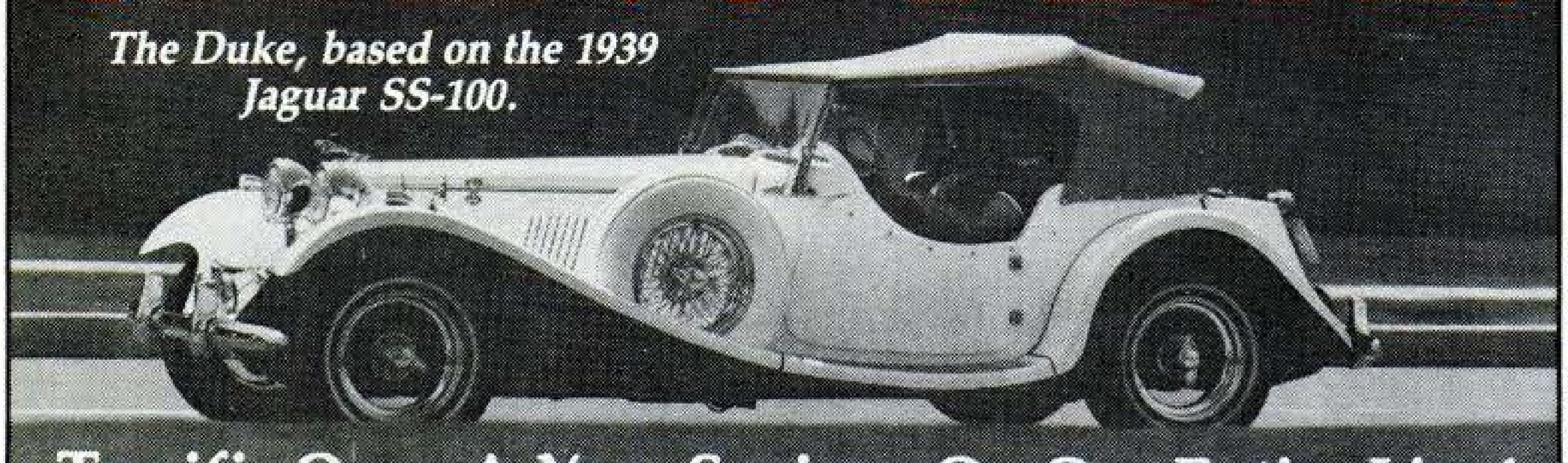

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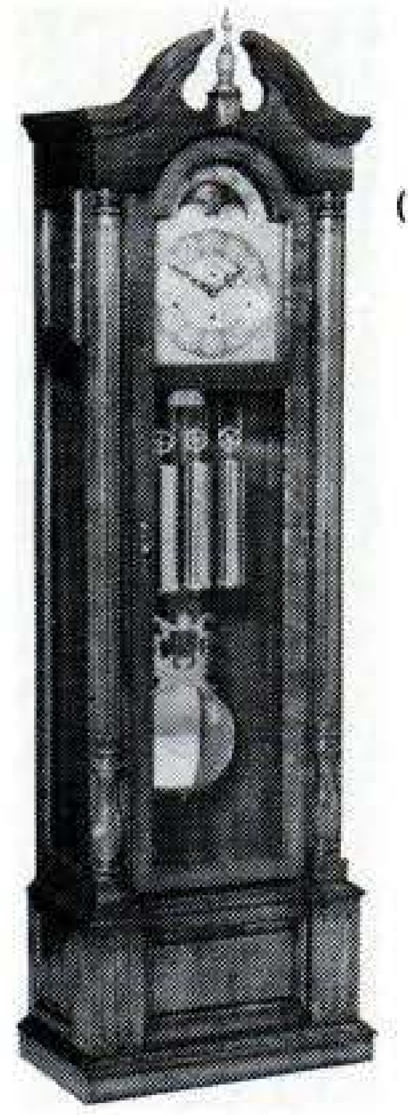

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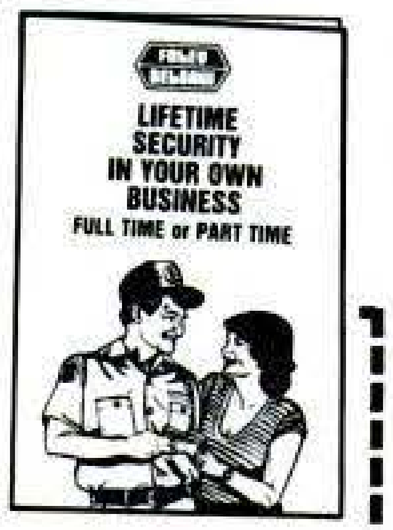
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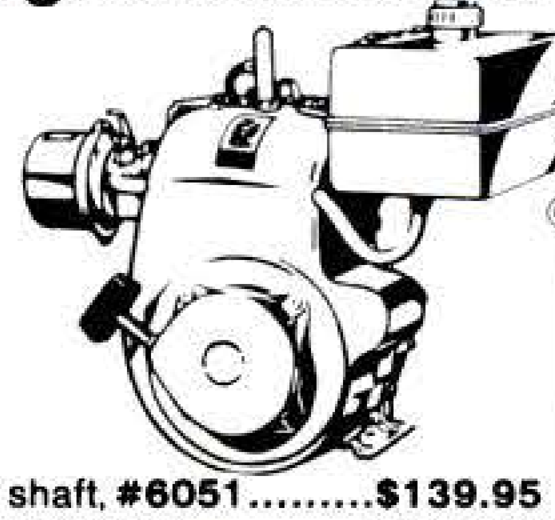

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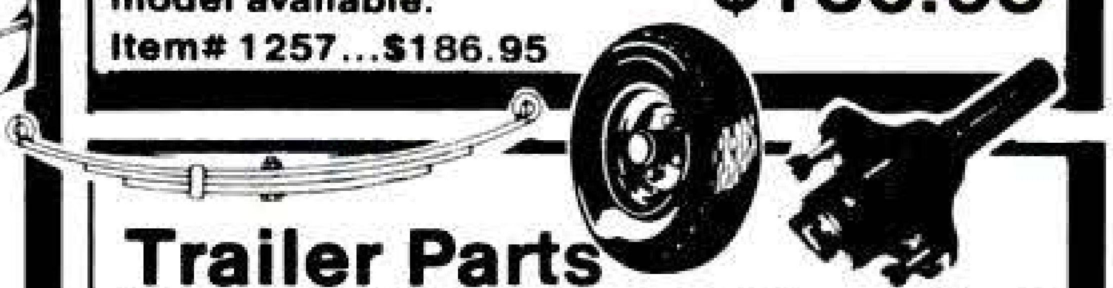

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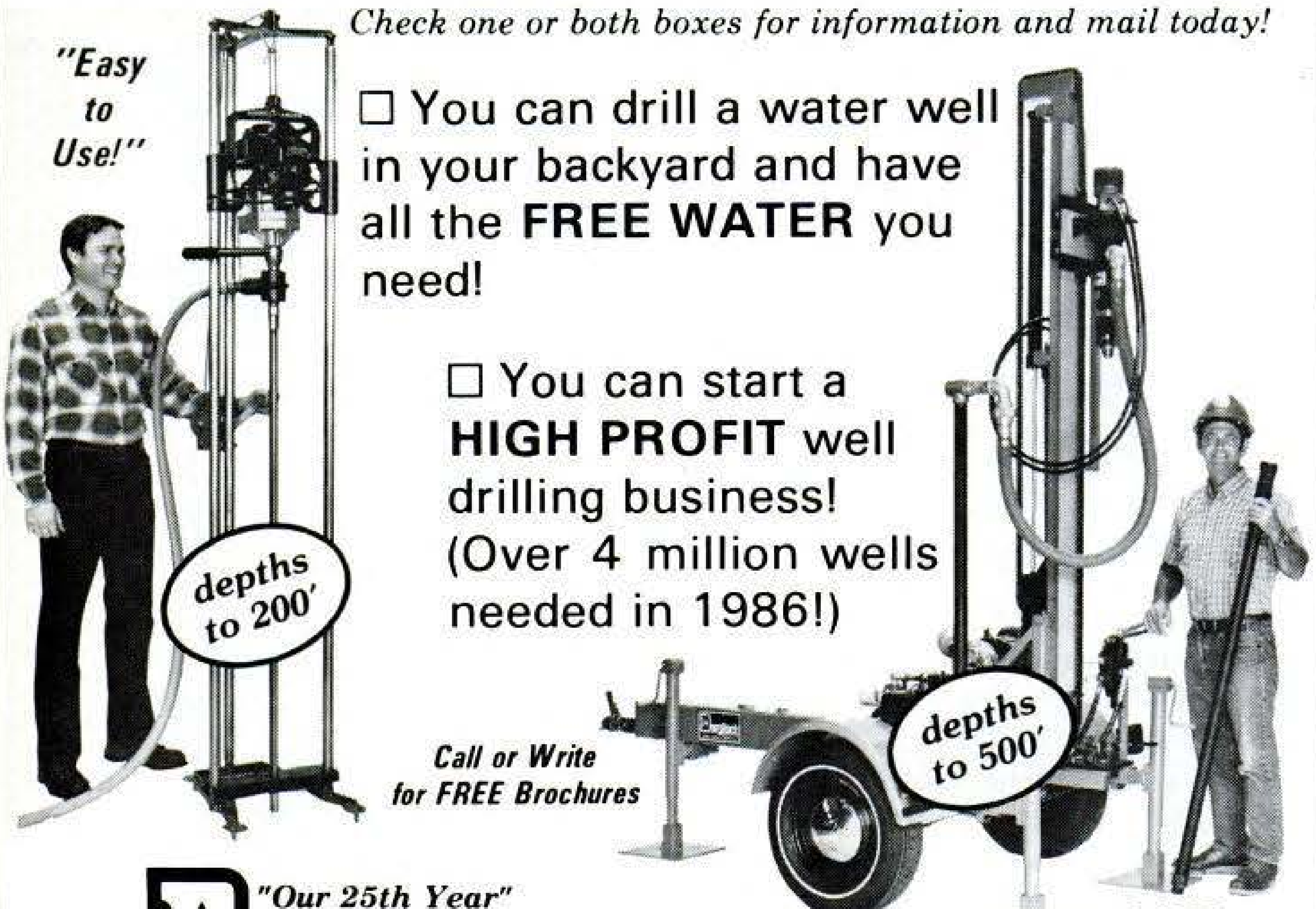

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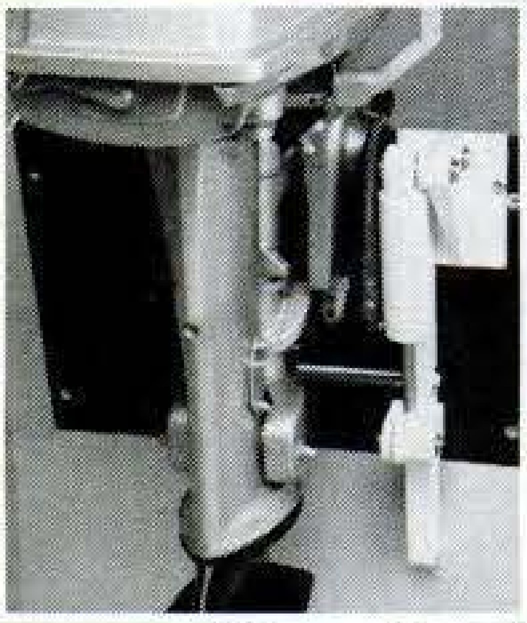

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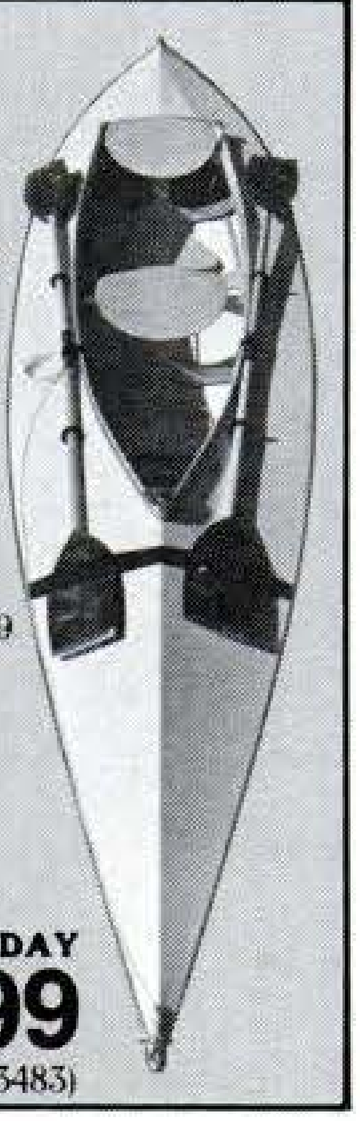

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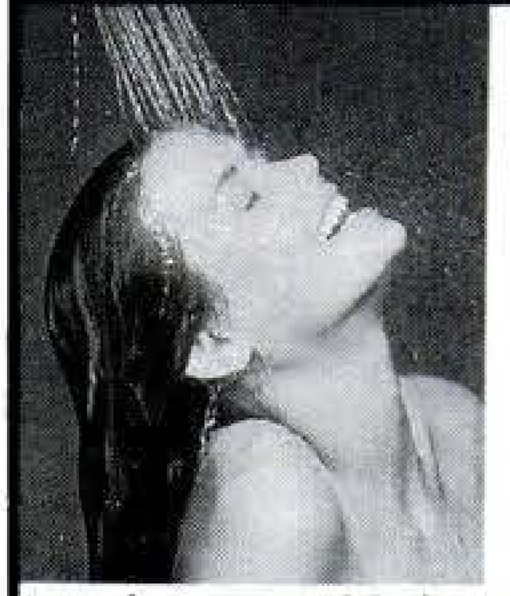

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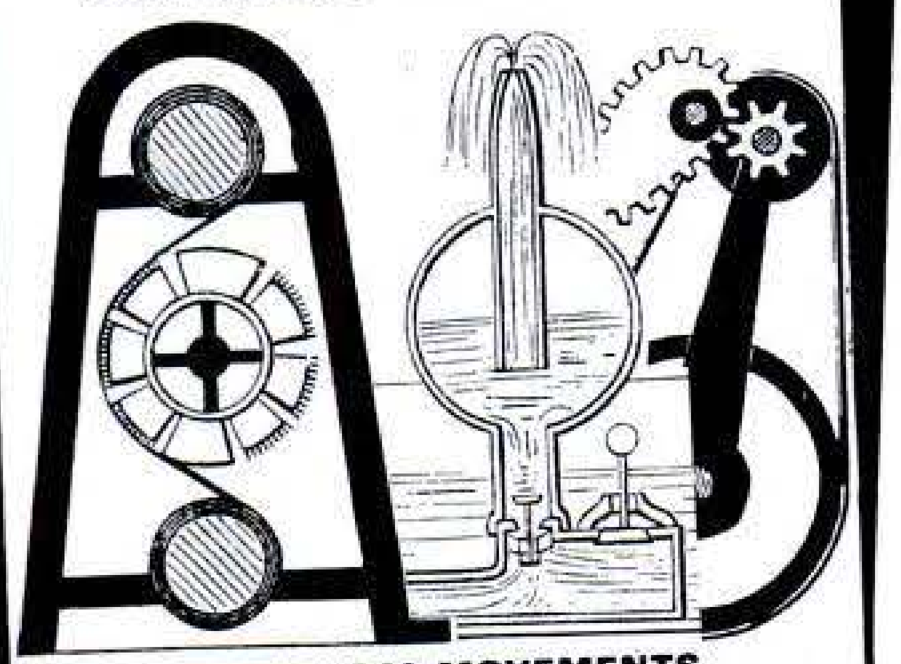

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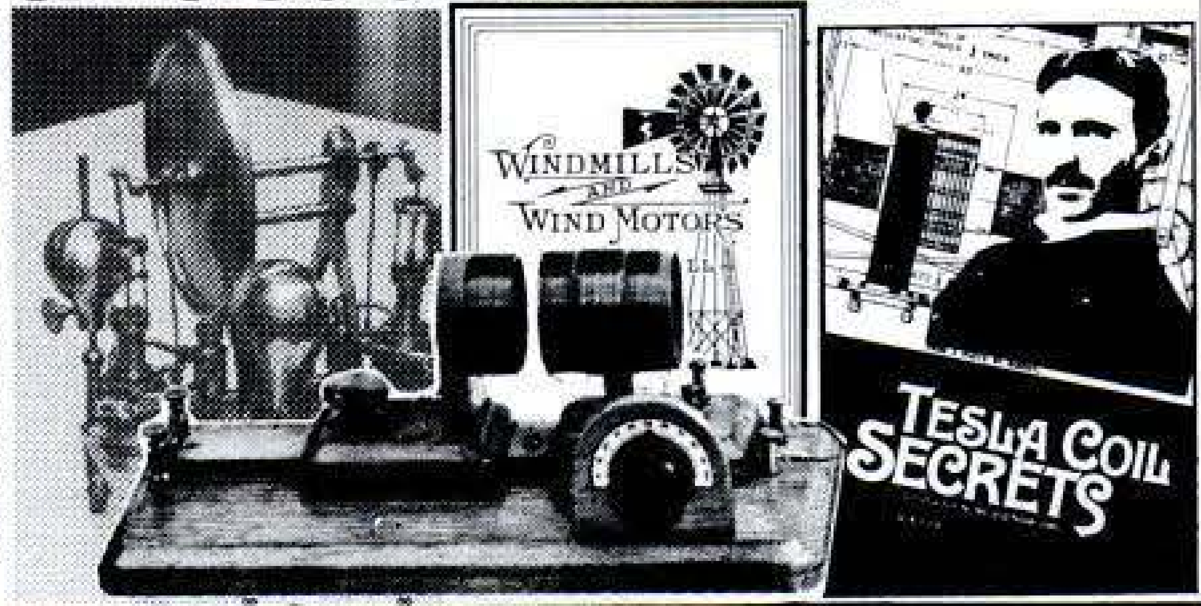

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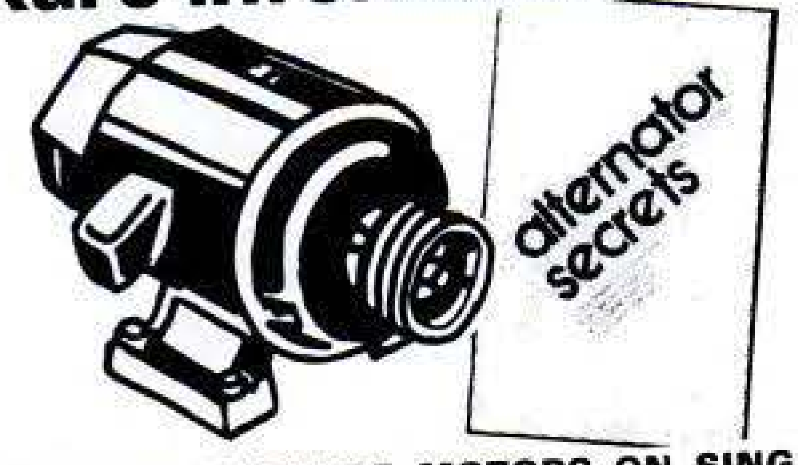

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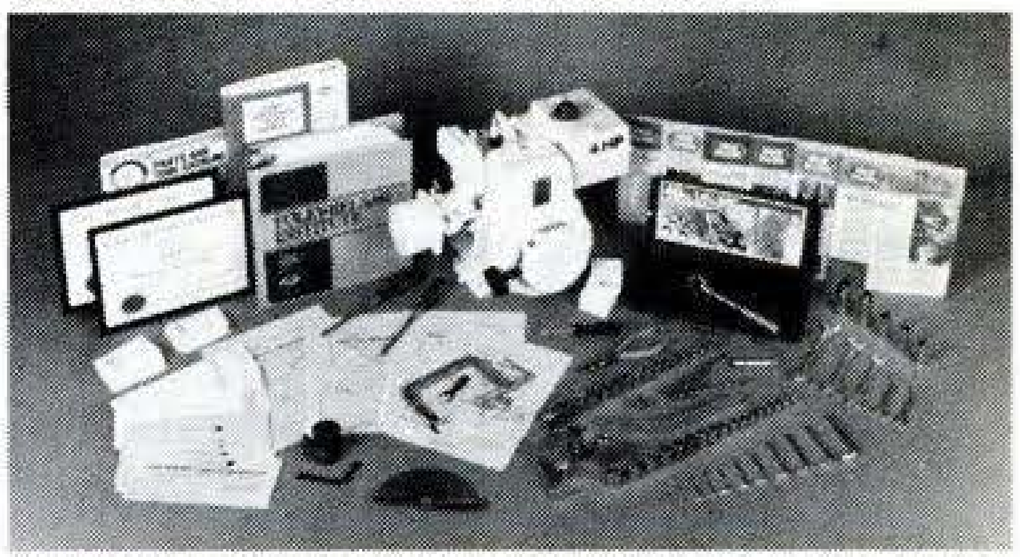

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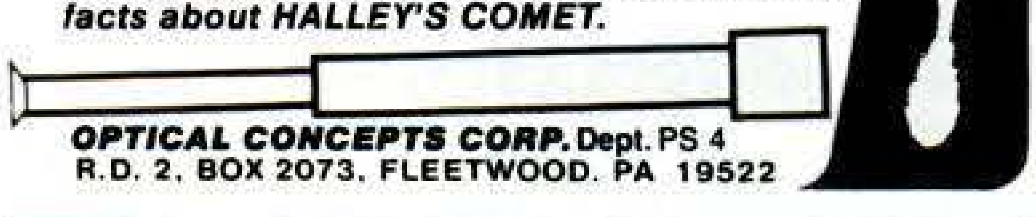

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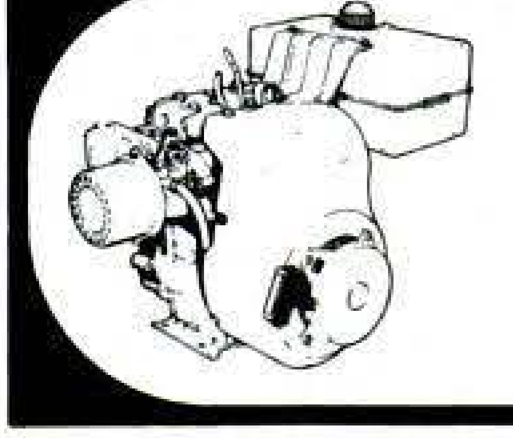

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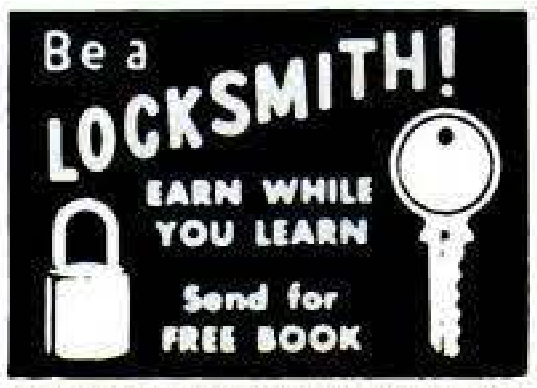

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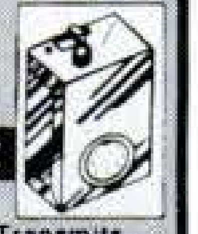

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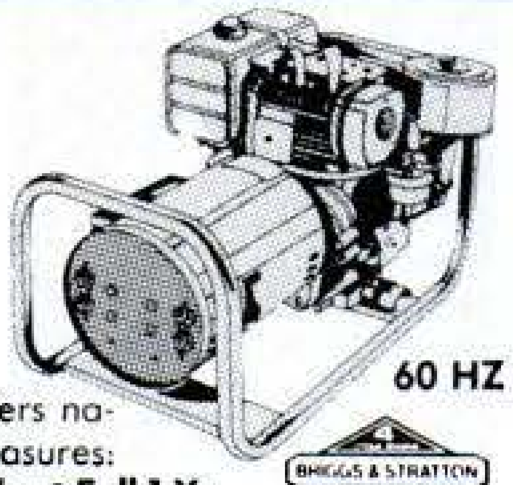

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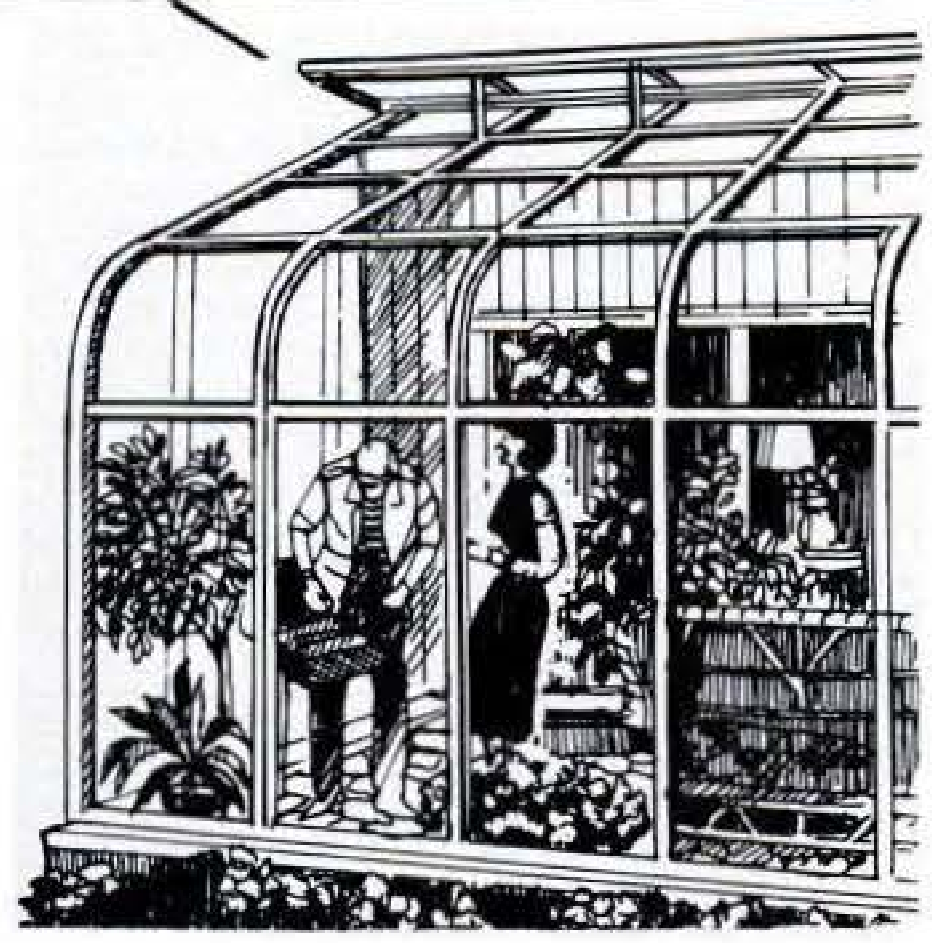

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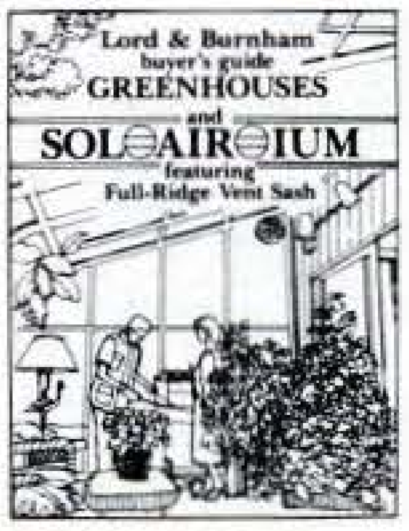

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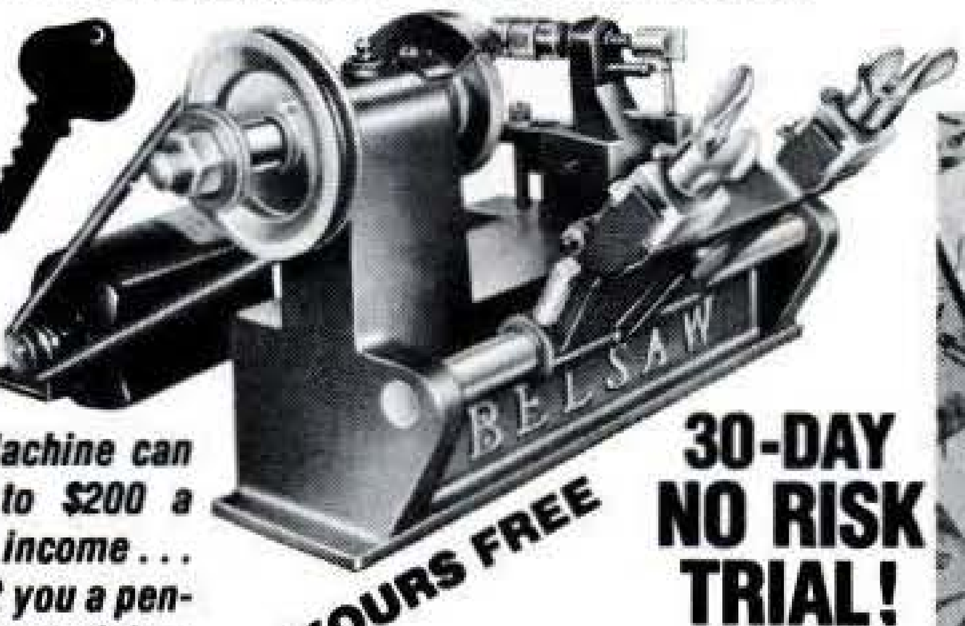

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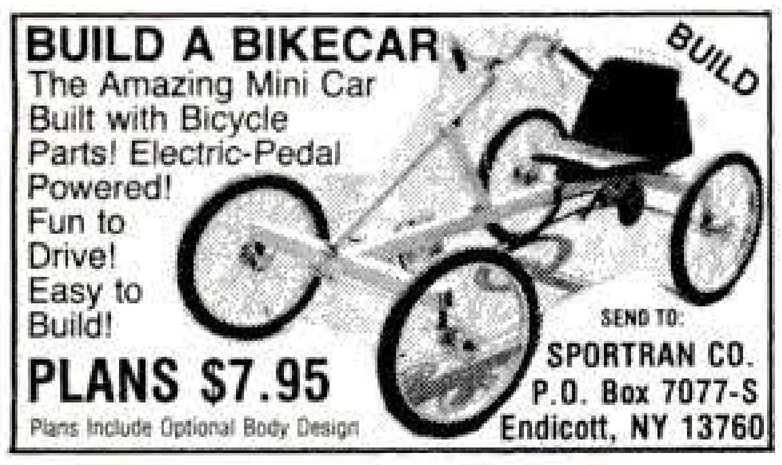

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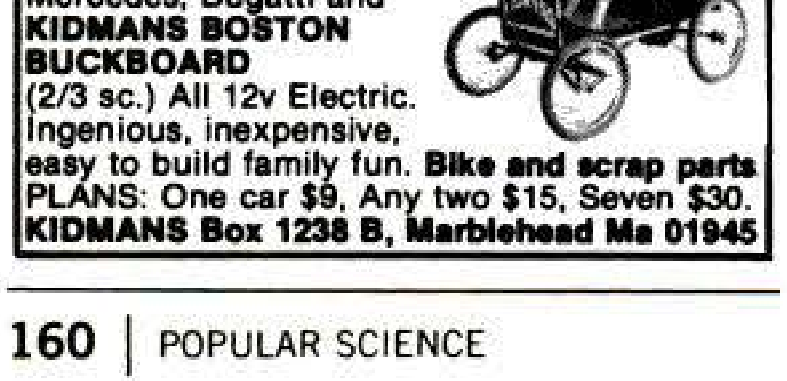

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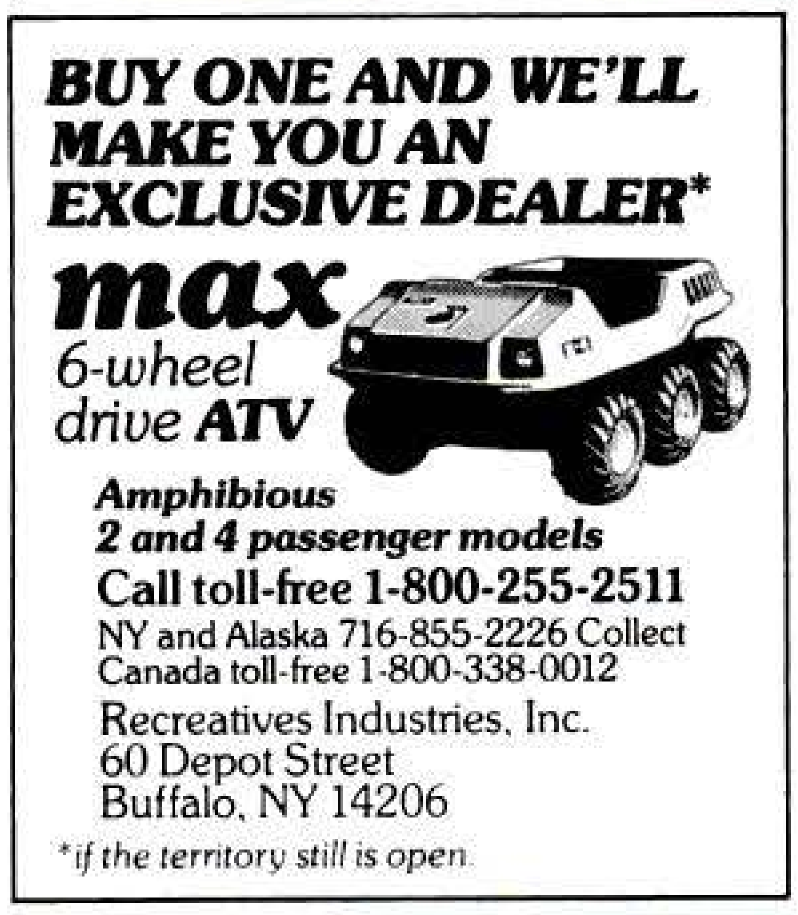

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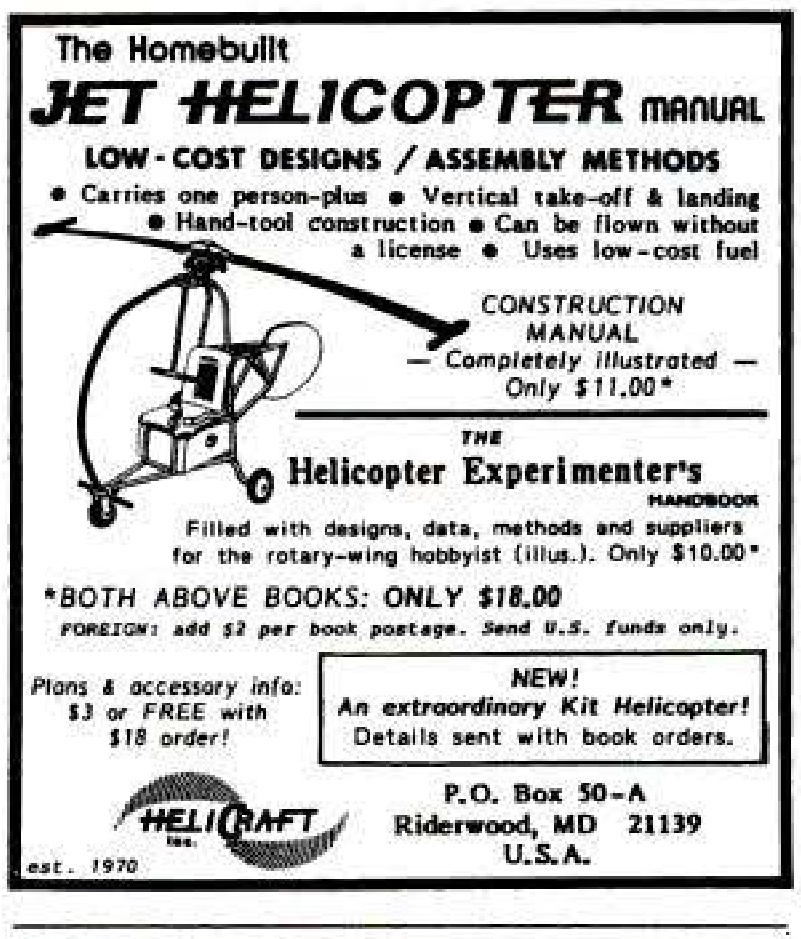

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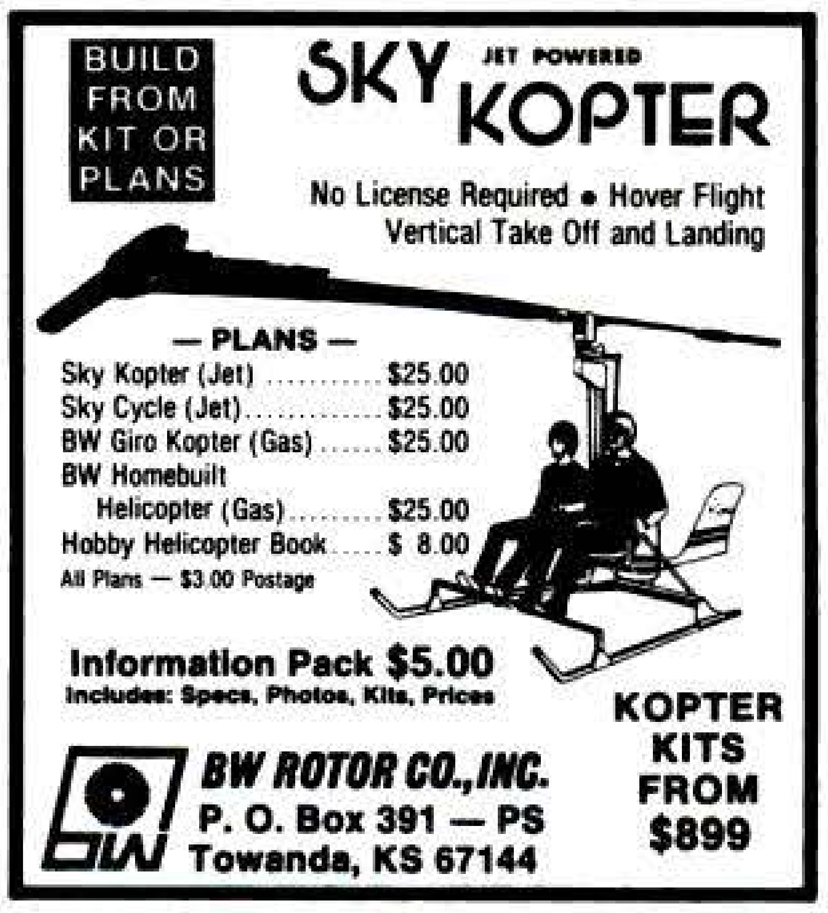

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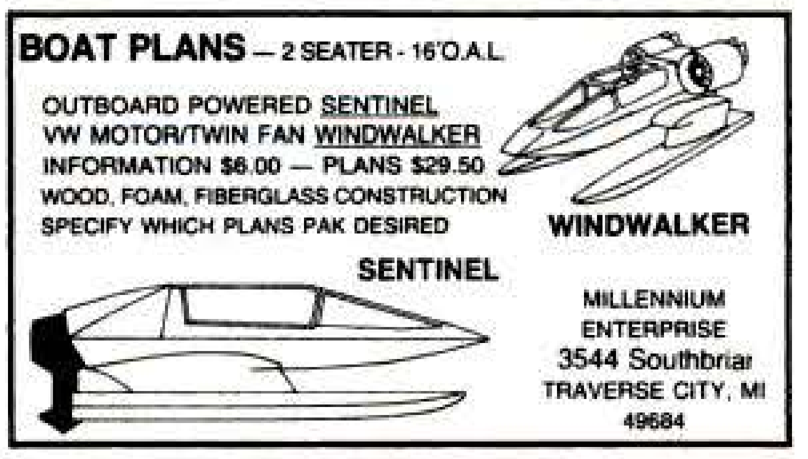

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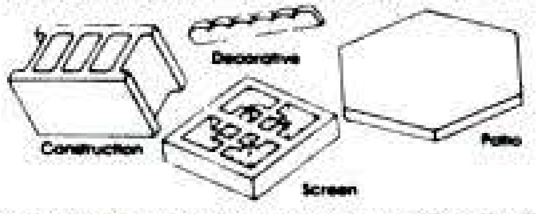

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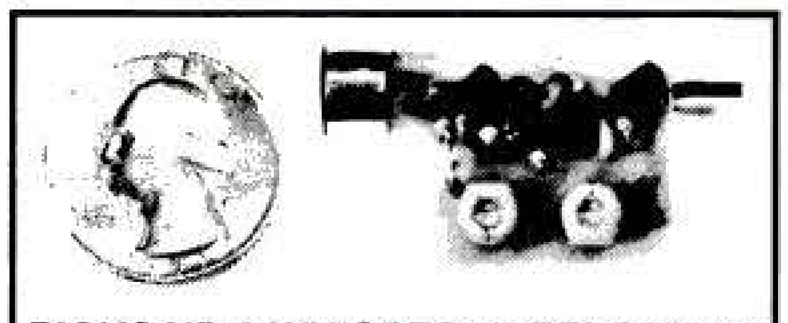

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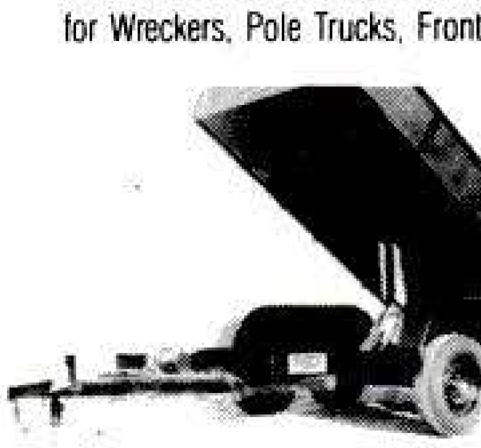

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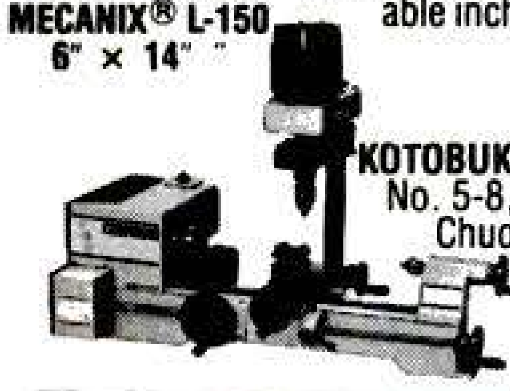

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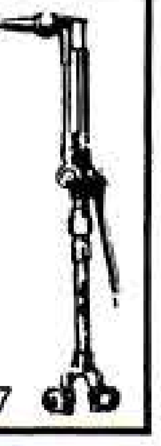

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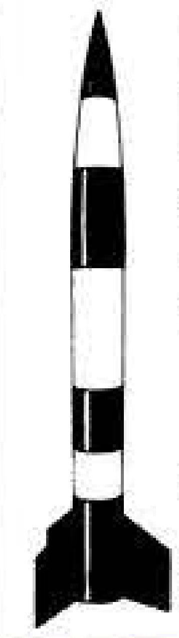

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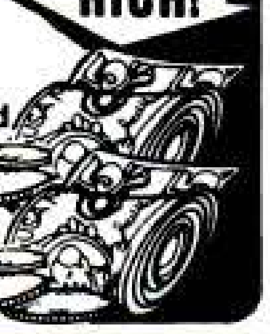

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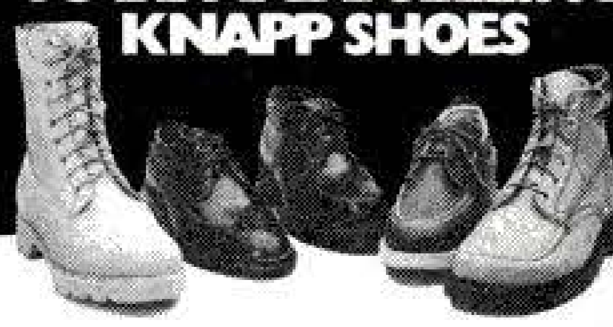

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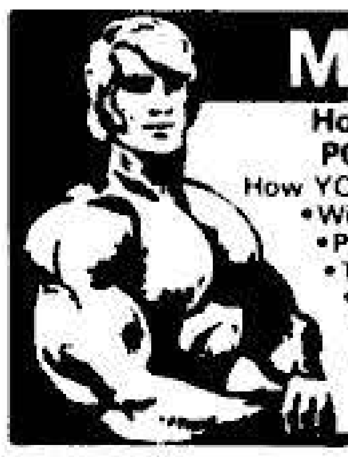

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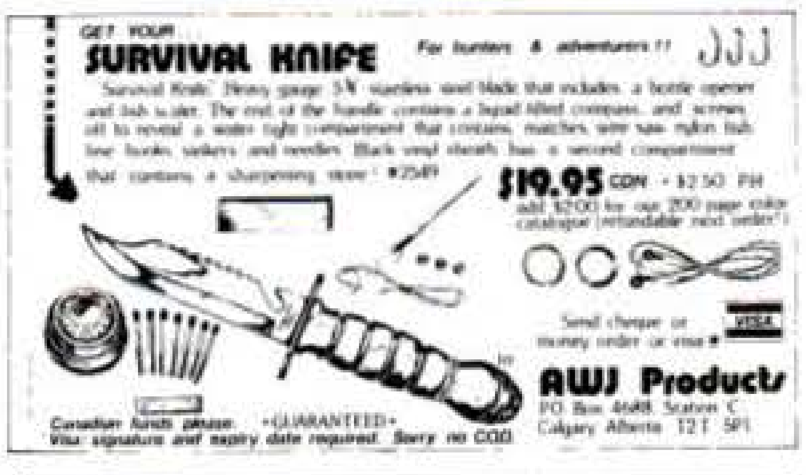
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415 Auto-Theft Deterrent A brochure from Ped-Al-Loc describes the company's anti-car-theft device. The UL-approved lock slides on and off a car's brake and gas pedals in seconds. Free

416 Satellite TV Buyer's Guide A 24-page buyer's guide from Satman gives details about free 100-channel satellite TV. The guide also outlines how to shop for an earth station. It lists the lowest prices on equipment and tells how to install your own earth station quickly and easily. Free

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420 Stud Finder A twofold brochure from Zircon International describes the company's Electronic Stud Sensor. The sensor electronically "sees" through walls to locate studs, ceiling joints, headers, and fire stops. The battery-operated device also measures wall density. Free

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